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THE

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A MONTHLY REVIEW OF

PRACTICAL MINING, QUARRYING, & METALLURGY,

AND

Record of the Mining and Metal Markets.

EDITED BY

HENRY CURWEN SALMON, F.G.S., F.C.S.

VOL. III.

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III. Section of Workings at Cook's Kitchen and Tincroft.
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THE

MINING AND SMELTING MAGAZINE.

JANUARY, 1863.

The Iron Manufacture of South Wales.

(*Rails.*)

By MM. Gruner and Lan.

(Abstracted from the *Annales des Mines*, 5th Series, Vol. xx, p. 515.)

General Considerations.

The Welsh iron districts, in the ordinary acceptation of the term, only include South Wales proper, that is, the counties of Monmouth and Glamorgan, and the southern borders of Brecknock and Caermarthen. But we may consider the Forest of Dean, in Gloucestershire, as naturally forming a portion of this important district.

The south of Wales owes its importance as an iron district to the vast coal-basin which borders the Bristol Channel on the north, almost without interruption, from the mouth of the Severn to the western extremity of Pembrokeshire. This favourable situation not only admits of the smelting of the ores of the coal-formation itself on the spot, but also of the obtaining, at a small cost, of the rich oxidised ores of the north of England, and of readily exporting the products obtained. In consequence of the small population in these districts, the make, as in Scotland, is confined to those products which, proportionately to their weight, require little labour; as rails and large merchant bars. It is only in the vicinity of the old centres of population, which are almost all situated near the sea, that some works have been established where the iron is more manipulated. Thus at Pontypool, Newport, Swansea, Neath, there are makers of tin plates and iron wire; while all the large works of the interior, such as Dowlais, Ebbwvale, Beaufort, Aberdare, &c., confine themselves to the making of rails, with a small proportion of bar-iron or heavy plates.

The iron industry of Wales dates three centuries back at least, for the Pontypool works were established in the time of Queen Elizabeth, and the blast-furnaces of Yniscedwin, which have been

worked with anthracite since 1840, and with coke from 1790 to 1840, had long previously been worked with wood.

Before the use of mineral fuel the principal iron works were situated more in the south-east of England—in the counties of Kent, Sussex, and Surrey—and the first large works in Wales were not established until about from 1780 to 1800. But their condition was far from flourishing until the commencement of the English railway period in 1820, and their increase was most rapid from 1830. When, about 1845, the home consumption of rails began to fall off, the exportation to the Continent, the United States, and to India, had so much increased that the Welsh works required to be still further enlarged.

In 1806 Wales already headed the other districts in the number of its furnaces. Of the 227 blast-furnaces in the United Kingdom, 52 were in South Wales, producing from 50,000 to 60,000 tons of pig-iron per year. In 1820 it furnished 150,000 tons. In 1825, 109 furnaces, of which 82 were in blast, produced 223,300 tons. It was between the two latter dates that the first English public railway, that of Stockton and Darlington, was commenced.

From this period the works already established were rapidly developed, and from year to year new works were added; thus Dowlais, the largest Welsh works, included at the time of its foundation in 1790:—

	2	blast-furnaces only;	
	3	„	from 1795 to 1809.
	4	„	„ 1810 „ 1819.
Afterwards	7	„	in 1820.
	11	„	„ 1825.
	13	„	„ 1835.
	17	„	„ 1840.
And	18	„	„ 1845.

Since then the number of furnaces has remained stationery, but the production of the works has been more developed by the progressive increase of volume of each of them. It will be seen by the dates we have just given that the rapid advance of Dowlais corresponds exactly to the period of the construction of the English Railways (1820 to 1840).

						Tons.
In 1827	Wales included	90	furnaces	in blast	producing ..	272,000
„ 1839	(according to Mushet)	122	furnaces	in blast	„ ..	453,880
„ 1857	(according to Hunt)	207	furnaces,	164 in blast*	„ ..	970,727
„ 1858	„	199	„	148 „	„ ..	886,478

We have thus in 1857 a maximum, since which the prices and production have dwindled from year to year, the North American demand having fallen off. In 1857 the total number of iron works in South Wales was 49: 39 (with 173 furnaces) in the bituminous coal district; and 10 works (with 34 furnaces) in the anthracite district.

The Forest of Dean (Gloucestershire) includes 5 works (2 in

* For the year 1854 Truran gives 176 furnaces in blast, and a production of 1,035,646 tons; but this seems an exaggeration, for the whole production of the United Kingdom was less in 1854 than in 1857.

operation) containing 10 furnaces of which 5 were in blast in 1857 and 4 in 1858. Their production of pig-iron was 23,882 tons in 1857, and 23,580 tons in 1858. This district only comprises one important works, that of Cinderford, where 3 furnaces out of 4 were in blast in 1857 and 1858.

On the whole it may be deduced from the figures given that during thirty years—from 1827 to 1857—the production of pig-iron in Wales has increased in the proportion of 1 to 4, while that of the whole United Kingdom has increased in the same interval as 1 to 5. This relative backwardness is due to the erection of the blast-furnaces of Cleveland, which since 1850 has been added to the old districts. In conclusion we may add that while the mean production per Welsh furnace was from 8 to 9 tons per day in 1827, it now reaches 20 tons; and that the consumption of coal per ton of pig during the same period has been reduced from 4 tons to 2¼ by the use of hot air and raw coal, and by the utilisation of the gases from the throat.

Raw Materials.—1. *Coal. The Coal-Basin of South Wales.* As the Welsh iron-works owe their existence to the rich coal-basin in which they are situated we shall first refer to that.

The basin proper of South Wales extends along the coast east and west, from the neighbourhood of Newport to the Bay of Caermarthen, a length of 60 miles, with a mean breadth of 15 miles. But besides this main field we find westward in Pembrokeshire, another narrow band, much broken up; and eastward the detached portions of the Forest of Dean and of Bristol, which may be included in the Welsh Basin. The approximate superficial area of this coal-basin proper is 1,030 square miles, of which 80 square miles belong to the Millstone Grit and 950 to the Coal-measures.

The Welsh coal-formation generally rests conformably on the Carboniferous Limestone; towards the west however it gradually extends beyond the Limestone and rests directly upon the Devonian and Silurian formations.

According to the labours of Conybeare, Buckland, and Logan, summed up by De la Bêche in Vol. I of the "Memoirs of the Geological Survey," the coal-formation of Bristol and of Wales is made up of four stages or series, the lowest of which corresponds to the Millstone Grit of the centre and north of England. Only, in the district we are speaking of, this lowest series is not clearly separated from the coal-formation; it must rather be considered as forming part of the Coal-measures.

The four series succeed each other in the following order:—

1. Upper coal-shale.
2. The Pennant Rocks of Bristol, and the Town-hill sandstones or central sandstones of Swansea.
3. Lower coal-shale.
4. Lower Grits, corresponding to the Millstone Grit; called Farewell Rocks by the miners.

Of these four groups the two shaly series are eminently carboniferous and rich in ironstone; while the lower arenaceous series is completely barren, and the upper one very poor to the east; but it has some good beds to the west, near Swansea.

The horizontal extension of these four series diminishes upwards, as in most coal-basins. The uppermost is indeed only completely developed at the two extremities, near Bristol on the east, and in the neighbourhood of Llanelly, Swansea and Neath on the west. The other series present themselves in bands, in concentric east and west zones, elevated on the north and south into a trough-like form.

The thickness and composition of the different series are far from being uniform in the various parts of the basin. The same bed can rarely be followed for many miles, especially in the upper grits. In this respect the coal-formation of Wales differs little from those of the Continent. To the east, near Bristol, between the Avon and the Mendip Hills, according to the "Memoirs of the Geological Survey,"* the thicknesses of the various series are as follow:—

	Feet.
Upper shales	1,800
Central sandstones or Pennant Rocks	1,725
Lower shales	1,565
Farewell Rocks	1,200
Total thickness	6,290

In the Forest of Dean:—

	Feet.
Upper shales	1,255
Central sandstones	1,055
Lower shales..	Wanting
Farewell Rocks	455
Total thickness	2,765

On the other hand, advancing from the Forest of Dean towards the west, the Lower shales are again developed: thus at Pontypool this series is 423 feet thick, at Ebbwvale 630 feet, at Merthyr-Tydvil 812 feet, and at Swansea at least 2 to 3,000 feet. The same is the case with the central sandstones, which rapidly increase from east to west.

The coal-formation generally attains an enormous thickness near Swansea. Sir E. Logan estimates it at nearly 11,000 and even 12,000 feet, including the still higher shales of Llanelly. The reverse is the case in the central part of the basin, Monmouth and Glamorgan, where most of the iron-works are situated, and where the upper series is entirely wanting, and the second—the Pennant Rocks—attains at the maximum 1,500 to 2,000 feet, and includes only three or four unimportant coal-seams of inferior quality. Next come the Lower shales, the average thickness of which is from 6 to 800 feet. This is the coal-formation *par excellence*, which furnishes almost the whole of the coal worked in Wales. These shales rest in their turn upon the lower grits (Farewell Rocks), the thickness of which rarely exceeds 200 feet. Thus in the most important part of the basin—that which is connected with the ports of Cardiff and Newport—the total thickness of the coal-formation cannot exceed at the maximum 3,000 feet. The whole rests upon the Carboniferous

* Geological Survey, vol. i, p. 212.

Limestone, the thickness of which varies between 500 and 1,000 feet.

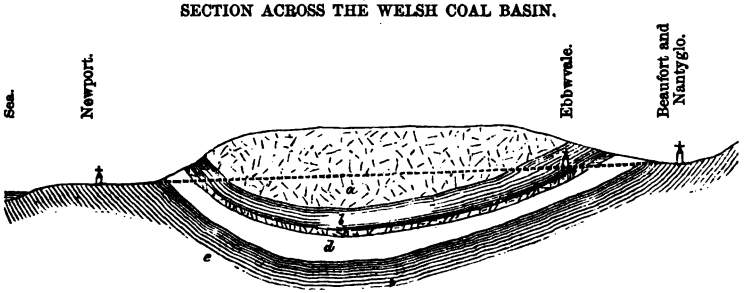
Near Swansea, where the coal-formation, including the Millstone Grit, measures 11,000 feet, there are 35 to 40 known seams of coal, of from 1 to 5 or 6 feet in thickness, or a total thickness of coal of 90 to 100 feet. But this, as we have seen, is exceptional. In the central portion, the true iron district, of which we have been speaking, the number of workable beds is at most ten to twelve, and their total thickness 30 to 40 feet; of this number two or three belong to the Pennant Rocks, and eight or nine to the Lower shales.

The variableness of the seams and the small relative extent of the workings do not admit of a valuation of the reserves of the South Wales coal-basin. The Survey itself has not hitherto attempted it; but at all events they must be very large, for we may allow at least 20 to 25 feet of coal over 500 to 600 square miles.*

The coal-field at its central part, between Newport and Swansea, forms a large table-land, more or less broken, which rises from the coast towards the old rocks of the higher Welsh hills. The general dip of the beds is comformable to this form of the surface. From their northern outcrop they dip towards the south, but become almost horizontal about the middle of the table-land, continuing so for some distance; they are then tilted up suddenly in an opposite sense before reaching the coast. This is the trough-like form we have already referred to, which will be best understood by the accompanying section, Fig. 1, which shows the various series, with their

Fig. 1.

SECTION ACROSS THE WELSH COAL BASIN.



South — North

a. Pennant rocks.
b. Lower shales.
c. Farewell rocks.
d. Carboniferous limestone.
e. Devonian: Old Red Sandstone.

respective thicknesses. This large coal-field is broken through north and south, by a certain number of valleys, determined often by large transversal faults, which form the natural outlets of the country. Since the last century these have been traversed by roads and canals, and since 1830 by numerous railways, all of which are connected, like the canals, with the ports of Newport, Cardiff, Neath, Swansea, or Llanelly. It was also towards the heads of these valleys,

* An estimate of the resources of this coal-field will be found in Mr. Hull's *Coal-Fields of Great Britain*, 2nd edit., p. 74.—ED.

on the line of outcrop of the Lower shales, that the first mines were opened, and the principal Welsh works constructed — Dowlais, Ebbwvale, Beaufort, Tredegar, &c. The coal-beds of the Pennant Rocks, and the higher beds of the Lower shales, have long been workable, and are still so at certain points as at Blaenavon, by horizontal galleries, or adit levels, driven from the bottoms of the valleys. Along the outcrop the ore was even formerly raised by open works, and afterwards by a series of small shafts, called bell-pits, with simple hand tackles.

At present the coal and ore are worked by large pits; but these pits, which are almost all sunk in the bottom or on the flanks of the valleys, generally penetrate immediately, or almost immediately, the Lower shale series. Consequently their depth rarely exceeds 100, 200, or at a maximum 300 yards. Besides, by means of these pits, aided by the regularity of the formation, the working is often pushed by levels or headings to under the very middle of the table-land rising between the valleys. In these pits the coal and the ore are worked simultaneously, or oftener alternately, in galleries opening at various levels.

These favourable conditions result in a relatively low cost-price; but still during the last thirty years there has been a sensible rise, especially as regards the ores—as has been the case in Scotland—for the workings are becoming gradually removed from the outcrop of the valleys where the principal iron-works are situated.

The most important collieries—those worked less for local consumption than for export, are situated in the Taffe Vale, which opens to the port of Cardiff. But besides these collieries whose special object is the working of the coal, there are others, which although specially worked for the making of iron, still sell a certain portion of coal. Such among others, are the Ebbwvale and Aberdare Companies, who sell a portion of the large while they consume the small and medium sized in their works. These conditions enable certain establishments to tide over the periodical crises which they have to undergo, and which always press heavier on the iron-trade than on the coal-trade.

In 1858 the South Wales basin, from 352 collieries, furnished:—

7,495,289 tons of coals and anthracite,* of which 737,590 tons were pure anthracite. Of this total the quantity exported to foreign countries was 1,369,350 tons of coal and 6,118 tons of coke.

Mr. Hunt's statistics for 1858 show also that the quantity exported from South Wales to other parts of England amounted to:—

By sea, 1,907,643 tons of coal and 18,715 of coke.
By railways, 159,093 tons of coal.

Making the total exports about 3,465,000 tons, including coal and coke.

We have thus a local consumption of about 4,030,000 tons of coal which may be approximately distributed as follows:—

---

* Thirty years ago, according to the authors of the *Voyages Métallurgiques* the total quantity worked in Wales was 2,600,000 tons, of which 1,700,000 tons were consumed locally.

	Tons.
For 886,500 tons of pig at 2½ tons	1,790,000
„ 550,000 tons of rails and bars at 2 tons 4 cwt. ..	1,210,000
„ 25,000 tons of copper made at Swansea, at 12 tons..	300,000
Sundry local consumption..	730,000
Total	4,030,000

The actual average cost-price of the coal brought to the works by the railways belonging to the mines, varies according to distance and quality between 4*s.* and 6*s.* 9*d.* per ton, not including allowances for interest or the redemption of capital. But these prices rise and fall with the rate of wages and the state of trade. In times of crisis wages are reduced, and the amount of dead-works is restricted. Thus in the case of one of the principal Welsh works, whose books were kindly placed at our disposal, we have been able to ascertain that in 1851 and 1852 (years of crisis), the cost-prices were 3*s.* 7*d.* and 3*s.* 6½*d.* per ton; while in 1853, 1854 and 1855 (years of prosperity), with a normal rate of wages, they were 4*s.* 7½*d.*, 5*s.* 1*d.* and 5*s.*

In the accounts, the cost-price is classed into the heads of (1) labour and (2) general charges. Under the latter head is comprised the royalties and the materials consumed, which in Wales amount to nearly 1*s.* 6*d.* per ton; that is, we may take from 1*s.* to 1*s.* 6*d.* for the collieries proper, and from 1*s.* 6*d.* to 2*s.* for those works where the general charges on the coal and ore are lumped together, to be divided again, at the end of the month, *pro rata* according to the number of tons of each raised. Thus in the works already named, where the general charges on the ore and coal are lumped together, we have for the years 1859 and 1860:—

	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Labour	3	2·04	3	5·24	3	6·04	3	7·76
General charges ..	1	5·67	1	7·48	1	10·77	1	6·62
Total cost-price ..	4	7·71	5	0·72	5	4·81	5	2·38

In another establishment, where coal alone is worked, we have ascertained that the cost-price per ton of 22 cwts. for the first months of the year 1860 was as follows, the general charges not even amounting to 1*s.*

	s.	*d.*	*s.*	*d.*
Labour and horse-work:—				
Hewing	1	4·6		
Tramming	0	5·5		
Dead-works	0	11·6		
Horse-work	0	4·0		
Weighing	0	·1		
Sundries	0	7·7		
Surface railways	0	·1		
Total labour			3	9·6½

* In an ordinary seam of from 4 feet 4 inches to 5 feet 4 inches in thickness, a man, earning 4*s.* per day, generally hews 2 tons of large and 1 ton of small, the coal being of average hardness. One ton of small is left in the workings, so that the seam furnishes in reality 50 per cent. of large.

	d.	s.	d.
Brought forward, total labour		3	9·6
General charges (royalty and raw materials) :—			
Royalty	9·0		
Timber	·7		
Iron (wrought and cast)	·3		
Coal for the engines	·8		
Sundry materials	·4		
Total general charges ..		0	11·2
Total cost-price		4	8·8

But owing to the commercial crisis this price is exceptionally low, for from 1854 to 1859 it was generally from 6*d.* to 8*d.* higher.

In 1843 when the rate of labour and the price of iron were as low as they are at present, according to Mr. Truran,* the cost-price of the coal at Dowlais did not exceed 3*s.* 2·5*d.* per ton, thus :—

	s.	d.
Labour and horse-work	2	5
General charges	0	9·5
Total	3	2·5

But then the royalty was at that time only from 3*d.* to 6*d.*, while now it is 9*d.*

On the other hand according to the authors of the *Voyages Métallurgiques*, in 1830 the coal at Abersychan, after deducting the royalty, only cost 2*s.* 5*d.* per ton long weight, while in 1858 and 1859 the cost price at these same works, including royalty, alternated between 5*s.* and 5*s.* 3*d.* These figures seem to indicate a rise of 70 to 80 per cent. in 30 years. But if the price given for Abersychan in 1830 be really correct, it is quite an exceptional one, for the authors themselves of the *Voyages Métallurgiques* give 4*s.* as the price of the coal in most iron-works in 1825.

It seems to us in fact that the average price of the coal in Wales has risen during 30 years from 4*s.* to 5*s.* Consequently this would be a real increase of 25 per cent., resulting in about an equal degree from the increased royalty and from the higher rate of wages. But this increase is more than compensated by the economy realised during the same period on the weight of fuel consumed in the blast-furnace ; so that the item of coal in the cost of making pig-iron is relatively less at present than it was in 1830.

We have already referred to the special characteristics of the Welsh coals. They are essentially short-flamed, burning slowly and without very much smoke. In the Memoirs of the Geological Survey, Vol. II, the composition of a large number of these coals is given. From it we see that the extreme types of fuel are the anthracite proper, leaving 92 to 93 per cent. of coke, and the ordinary caking coals (of Pontypool for example) which lose as much as 35 per cent. of volatile matters. But most of the coals of the iron-district are equally removed from these two extremes, and leave,

* Truran, p. 168.

on an average, in a close vessel, from 75 to 80 per cent. of good coke. The average short-flamed coals specially characterise the central district of Cardiff; while that of Newport to the east, includes more gaseous coals, giving in a close vessel only from 65 to 70 per cent. of coke; and that of Swansea, to the west, the numerous anthracite coals yielding from 85 to 90 per cent.

These coals consequently are essentially suitable for employment in a raw state in the blast-furnace; and in fact they are so employed in a large number of works. But, from the fact that they are short-flamed, they are softer and more friable than those of the other districts of the United Kingdom; so that the proportion of small is consequently greater than elsewhere, and the small cannot be used in the furnace without being agglomerised or carbonised. Agglomeration has not hitherto been practised, but doubtless it will some day in the anthracite district of the Vale of Swansea. But carbonisation is applied at once to large and small—to the large principally for the purpose of desulphurisation so as to produce purer iron. In this case the operation is performed in mounds or kilns; but generally in Wales the small is carbonised by itself in vaulted rectangular ovens.

At Dowlais, which is on the table-land on a level with the tops of the furnaces, there is one building containing 60 of these ovens, in two ranges of 30 each. These are successively discharged by means of an endless chain, worked by a small horizontal steam-engine, and the coke is taken direct by railway to the throat of the furnace. Each oven is charged with about 1 ton 6 cwt. of coal. Each operation lasts 48 hours and produces, on an average, one ton of compact coke, of a steel-grey colour, and which on cooling splits into long prismatic masses.*

The cost of making the coke, which, as we have said, is not calculated separately, but is included in the total cost of the furnace, is estimated at 1*s.* 4*d.* per ton. In other works the carbonisation of the small is effected in a similar manner. It is only surprising that the utilisation of the small is still so little attended to in Wales: the English iron-masters would certainly find it a considerable source of profit, especially if, in the carbonisation they adopted the coke-ovens of the brothers Appolt.

2. *Iron Ores.*—The iron ores smelted in the Welsh works are essentially of two kinds: the Coal-measure ores of the district—*Welsh mines*—and the *red ores* of the north of England.

Besides these, certain works obtain a little rich ore from the island of Elba, from the north of Spain, and especially from Cornwall. No other iron district imports so much ore as South Wales. And besides with the ores they re-smelt, in almost all the works of the district, the entire mass of the forge-cinders.

The quantities of the various ores annually treated in the Welsh works is not given exactly in the tables of the Geological Survey, but they may be indirectly approximately deduced. The quantity of pig-iron produced in 1858, was 886,478 tons, of which 850,000 was

* A description of these ovens is given in Dr. Percy's *Metallurgy*, p. 196, where the whole subject of fuel and coking is treated exhaustively.—ED.

refined. Now on an average it requires 2 tons 8 cwts. of ore and cinders per ton of pig; making consequently for the year 1858 a total 2,127,547 tons. On the other hand 100 of pig-iron yields on refining from 40 to 45 or at most 50, of forge cinders. Thus the total produce in cinders in the Welsh works in 1858 amounted at a maximum to 430,000 tons. The quantity of *red-ores* smelted in Wales the same year was about 580,000 tons, for out of a total produce of 877,740 tons, according to Hunt, about 300,000 tons found their way into other districts.

The same statistics give for the counties of Cornwall, Devon and Somerset, a total of 85,945 tons, all intended for the Welsh works.

Lastly the *Welsh-mines* show, according to Mr. Hunt, a total of 752,231 tons, of which 24,635 tons were brown hematite, and 727,596 tons clay-ores.

There remains the foreign ores proper, coming from Spain and the island of Elba, whose quantity is not given, but which from information collected by ourselves on the spot, would at most amount to 50,000 tons.

Now if we add these different quantities we find a total of 1,898,176 tons, instead of 2,127,547 tons; this shows a deficiency of 230,000 tons principally no doubt in the ores of the district, but also arising to some extent from supplies left from former years. But in any case, it is very evident that the quantity of the Coal-measure ores is much greater than is indicated by the statistics of the Geological Survey.

In conclusion it may be taken that there was approximately smelted in the Welsh works in the year 1858 the following quantities:—

	Tons.	per cent.	Pig-iron.
Ores of the district (*Welsh-mines*) ..	980,000	at 32 giving	313,000 tons.
Imported ores:—			
Red hematites (*red ores*)	580,000	„ 50 „	290,000 „
Ores of Cornwall and Somerset ..	86,000	„ 50 „	43,000 „
Foreign ores (especially Spanish) ..	50,000	„ 50 „	25,000 „
Forge-cinders	430,000	„ 30 „	215,000 „
Total	2,126,000	producing	886,000 „

We see by this that the *imported ores really furnish more iron than those of the district*, for the latter give only 313,000 tons against 358,000 tons furnished by the former. Thus the Welsh blast-furnaces are not so favourably situated with regard to ores as is generally supposed in France. If there be any error in the figures we have given it will be in the ores of the district, whose quantity we have added to at the expense of the imported ores. The 358,000 tons stated to be produced from the latter is consequently a minimum, and tends to increase year by year. Thirty years ago, according to the authors of the *Voyages Métallurgiques*, the use of imported ores was entirely exceptional; and even in 1854, according to Truran, they only amounted to 350,000 tons.*

The Welsh Coal-measure ores are not less pure than those of the

* Truran p. 176.

centre and north of England: they differ from them mostly in giving a less percentage, for in a rough state they only yield from 30 to 32 per cent. of iron. If, notwithstanding this, and the addition of the rich and pure red hematites of the north, the ordinary Welsh iron is inferior in quality to that of Staffordshire, it is solely due to the general employment of forge-cinders, and the special mode adopted in working the furnaces. Instead of grey pig they produce white pig, often granular and cavernous, and which besides is puddled too rapidly and without the least care. The pigs and bars obtained at Pontypool and Blaenavon and some other Welsh works abundantly prove that this district is quite capable of turning out superior products. To effect this it only necessary to abandon the use of cinders, and to adopt suitable modifications in the method of working.

The Welsh carbonated ores are found (like the coal) more particularly in the Lower shale series, and principally in the lower portion of these shales. The total number of bands is considerable, amounting in some places to nearly a hundred. Thus in a section of the western part of Pembrokeshire given by De la Bèche in the Memoirs of the Geological Survey, 97 veins are met with. At the Plymouth works, near Merthyr-Tydvil, 82. At other points where the Lower shales alone exist:—

At Cefn-Crebwr, in Glamorgan	31
„ Ebbwvale, in Monmouth	27
„ Pontypool, „	21

The total *workable* thickness of these bands necessarily varies from one part of the district to another, and is not given in the Memoirs of the Survey. Mr. Truran estimates it at 22 feet; but this is evidently an exaggeration, at least if we only calculate the workable bands and the real thickness of the ore proper. If this were correct the quantity (in volume) of the ore would be equivalent to half that of the coal, and its weight would be considerably greater. In this case the working of the coal would evidently proceed much more rapidly than that of the ore, since they now extract per year, 7 millions tons of coal, against one million tons of ore; and if this were so it would be difficult to understand the motive for importing such large and increasing quantities of other ores.

On referring to the section of the Survey, it will be seen that a large number of bands are only from 1 to 2 inches thick, while the average is certainly under 3 inches. Thus in those localities where there are 80 to 100 bands, although the total thickness of the ferruginous deposit may amount to 20 or 25 feet, only half the bands at most are really workable; and in the iron district proper, where they are confined to the Lower shales, that is to 20 or 30 bands, not more than from 5 to 7 feet of workable ore can be calculated on; an estimate which nearly approaches the 7½ feet given by the authors of the *Voyages Métallurgiques*. Notwithstanding this, even taking the lower estimate of 5 feet, it will be seen that Wales is rich in ore, for the iron as well as the coal extends over an area of 500 to 600 square miles. But the raising the ore is throughout costly. The same working rarely includes more than two bands, very often only

one, of from 4 to 6 inches, which is the minimum workable thickness. The maximum thickness of the thickest bands is from 10 to 12 inches.

Hence the average cost price per ton of ore is 8*s.* to 10*s.* at the pit's mouth, and at the furnace 9*s.* to 11*s.*; the royalty being 4*d.* to 5*d.*

The following are the particulars of the cost-price per ton (of 22 cwts.) of the ore at the same works of which we have already given the price of the coal. It refers to the first months of 1860, and may be taken as considerably lower than the ordinary average.

Labour and horse-work :—

	s.	*d.*	*s.*	*d.*
Breaking*	5	10·1		
Tramming	1	1·4		
Dead-works	1	2·1		
Sundry labour	0	2·3		
Carriage to furnace and weighing	0	2·2		
Horse-work	0	7·2		
Labour and horse work			9	1·3

General charges (royalty and raw materials) :—

	d.		
Royalty	4·9		
Timber	1·4		
Iron (wrought or cast)	·9		
Coal for the engines	1·5		
Surface roads	·4		
Sundries, materials	1·7		
	—	0	10·8
Total general charges		10	0·1

In the same works in 1859 the cost-price was from 5*d.* to 7*d.* higher. In another establishment in 1859—

Labour :—

	s.	*d.*
Breaking	5	5·75
Tramming	1	4·4
Dead-works	0	7·98
Spalling and picking	0	2·1
Repairs of ways	0	0·73
Sundry labour	0	3·32
	8	0·28
General charges	2	0·0
Cost-price delivered at the furnace	10	0·28

In other works also we have ascertained that from 1854 to 1860 the price varied between 9*s.* 6*d.* and 11*s.*

In Wales the ore therefore costs delivered at the furnace :—

At a minimum 8*s.* 6*d.*

On an average about 10*s.*

And at some exceptional works like Pontypool and Blaenavon 11*s.* to 13*s.*

* The men employed in breaking the ore earn less than the hewers of the coal. While the latter earn 4*s.* per day, the former only earn 3*s.*; and rarely break more than from 10 to 12 cwt. per day of ore proper.

Comparing these prices with those of 1830, it will be seen that the price of the ore has increased more rapidly than that of the coal. Instead of an increase of 25 per cent., it is rather from 40 to 50 per cent. Thus at Abersychan, the ore was quoted at 6*s.* 8*d.* in 1830, whereas we have found it to be 10*s.* in 1860; and in most other works there has been certainly nearly a proportionate increase, which is principally attributable to the fact that 30 years ago the ore was raised by open-cast workings, or by shallow bell-pits.

The red hematites or *red ores* of the north of England which are so largely used in the Welsh works, have an average produce of 50 per cent.; but their cost-price is nearly double that of the *Welsh mines*, it being from 10*s.* to 20*s.* per ton delivered at the works. These ores as we have seen contain very little sulphur or phosphorus. Treated by themselves they produce good forge-pig, but are more silicious, more compact, and less reductible than the calcined Coal-measure ores. In this respect they resemble forge cinders.

Lancashire supplies the red hematite in the proportion of 70 to 75 per cent., and Cumberland in that of 20 to 25 per cent. The calcareous ores of the Forest of Dean only reach 10 per cent. The *red-ores* of Lancashire are conveyed by the Furness railway to the port of Barrow for shipment.

	s.	*d.*		*s.*	*d.*
Their cost at Barrow is from	10	6	to	11	6
Freight from Barrow to Cardiff or Newport..	5	0	„	5	6
Carriage by railway to the works	2	6	„	2	6
	18	0	„	19	6
The richest Cumberland ores embarked at Whitehaven cost	12	0	„	14	0
Freight to Cardiff or Newport	5	0	„	5	6
Carriage to the works	2	6	„	2	6
	19	6	„	22	0

The other imported ores used in the Welsh works are quite as dear. Thus the spathic ores and brown hematites of Somerset and Cornwall cost 18*s.* to 22*s.* per ton. The Spanish ores (Garrutcha or Sommo Rostro) bring 17*s.* to 19*s.* 6*d.*, and those of the island of Elba, whose use is quite exceptional, 24*s.* to 25*s.* These countries, however, scarcely furnish 2 per cent. of the ores used.

But there remains one more ore whose use is of extreme importance in the Welsh works: that is forge-cinders, the proportion of which amounts to 20 or 21 per cent. of the average charge of the Welsh blast-furnaces. It is these cinders alone, owing to the high price of its ordinary ores, which enable Wales to compete with Scotland, and more particularly with Cleveland. But on the other hand it is solely to these cinders that the great inferiority of the South-Wales iron is due. The phosphorus in the iron concentrates in them, and constantly re-appears in the subsequent products, with, in addition, a proportionate increase of silicium, notwithstanding the cold working of the furnaces.

Forge-cinders, however, whatever their origin, are rich ores, containing from 60 to 80 per cent. of oxide of iron, with from 10 to 25

per cent. of silica. Still their use is not so profitable as their percentage would seem to promise, for, according to the experience of Dowlais, these cinders only yield in Welsh blast-furnaces with a cold working, 30 per cent. of iron, leaving the other half of the oxide of iron in the slags. In some works the cinders are only charged at the cost of their carriage from the forge to the throat of the furnace. At others they are put down at the price paid for them to the forges by the neighbouring furnaces. In the first case they cost, according to situation, from 3*d.* to 6*d.*; in the second from 2*s.* to 3*s.*

The Welsh Coal-measure ores are calcined in kilns. This costs 3*d.* per ton and causes a loss of from 25 to 30 per cent. Calcining in heaps is costly and is only used when, as at Yniscedwin and Ystalyfera, near Swansea, the ores are shaly and mixed with coal like the Scotch blackbands.

3. *Limestone.*—The limestone used in the Welsh works is procured exclusively from the Carboniferous Limestone; and as the mines are almost all situated along the northern border of the coal-field, where the limestone crops out, it is worked open-cast in quarries, rarely more than 3 or 4 miles from the furnace. The carriage to the works is generally by private tramway at a cost of between 1*d.* and 1½*d.* per ton and mile.

In most works the price of the limestone varies between 1*s.* 8*d.* and 2*s.* 2*d.* per ton long weight of 22 cwts., made up as follows:—

	s.	*d.*		*s.*	*d.*
Labour for raising	1	0	to	1	3
Sundry supplies	0	3	„	0	3
Royalty	0	2·5	„	0	3
Carriage 3 or 4 miles	0	3	„	0	5
Total cost-price	1	8·5	„	2	2

Mr. Truran gives for the year 1843, the exceptional price of 8·5*d.*, when wages were very low and the royalty 1$\frac{4}{10}$*d.* But at present there are few works where the limestone costs less than 1*s.* 6*d.* Still the price has lowered a little during 30 years in consequence of the construction of railways, for in the *Voyages Métallurgiques* they give the price as 1*s.* 6*d.* to 3*s.* 6*d.* In most Welsh works at present, the limestone costs 1*s.* 5*d.* to 1*s.* 10½*d.* per ton at the furnace.

Sulphuretted Hydrogen as a Precipitating Medium in the Treatment of Poor Copper-Pyrites.*

By Carl Weltz.

In the case of the cupriferous pyrites of Norway it frequently happens that the copper is so distributed that mechanical separation is economically inadmissible. As the ore is too poor to admit of

* Condensed from the *Berg- und Hüttenmännishe Zeitung.* No. 15, 1862.

immediate smelting, the well-known kernel-roasting process* is employed in the first place, to make a mechanical separation possible.

Whether this process has ever been attended with satisfactory results in Norway is to be doubted. From being carried on in kilns open to the air and exposed to every atmospheric influence, but an uncertain result can be expected, and the concentration of the copper in the kernel can only be effected in the kilns. The subsequent hand-separation is also difficult, imperfect, and costly. Under these circumstances, a continuation of this mode of treatment for these ores, which although poor for copper are rich for sulphur-pyrites, can scarcely be expected. In order really to utilise these deposits it is necessary to find some means of making the sulphur available.

With this aim experiments have been made in many variously constructed apparatus, but no economically advantageous result has been attained as far as regards the obtaining of sulphur. But in making these experiments another phenomenon was observed which soon gave them a direction as unexpected as it was satisfactory, and which threw the saving of the sulphur again into the backgrouud. It was found that under certain circumstances Sulphuretted Hydrogen was developed; and that on such an energetic scale as to lead to the anticipation that this gas might be applied as a cheap precipitating medium for copper on a large scale.

The possibility of generating large quantities of Sulphuretted Hydrogen was no longer to be doubted, but it remained to be seen how far its application on a large scale, as a precipitating medium, could be practically and economically utilised; and this could not be decided with certainty without further investigation. This was greatly facilitated by the existence of large quantities of residues of an early working of the kernel-roasting process, which contained much copper, particularly in a soluble form as sulphate of copper.

It was the object of further investigation to bring these salts, thus soluble in water, into contact with Sulphuretted Hydrogen in a suitable manner. Up to the present time the best method that has been found for effecting this in such a way that none of the Sulphuretted Hydrogen should escape unused, has been that of allowing the gas to enter several connected chambers into which the solution is showered like rain. The result of this arrangement is generally very satisfactory, for the reaction goes on with ease and without loss of gas. The precipitate sinks easily to the bottom in the mother-liquid, and the further treatment of the sulphide of copper obtained in this way, presents no essential difficulties.

Thus the problem is solved, and a chemical process, hitherto confined to the laboratory, is found to be advantageously applicable on a large scale; succeeding in converting poor copper deposits, which before its application were almost worthless, into valuable mines.

Let us now turn to the apparatus itself as it is at present in use. As it has not to bear a very high temperature, it may be built of almost any kind of good stone, as gneiss, granite, mica-slate, or sandstone; any escape of gas through which, may be obviated by the

* For a description of this process see Dr. Percy's *Metallurgy*, p. 439.—Ed.

construction of an outer wall 6 to 8 inches thick, the space (2 or 3 inches) between the two being filled up with fine sand.

As, in the immediate influence of the flame upon the pyrites, the presence of free oxygen interferes with the formation of Sulphuretted Hydrogen, or again decomposes that already formed, a principal condition for the success of the process is, that all free oxygen or such combinations of it as decompose Sulphuretted Hydrogen—for example sulphur acids—be excluded from the apparatus.

Figs. 2, 3 and 4 give a series of rough plans and sections of the

Fig. 2.

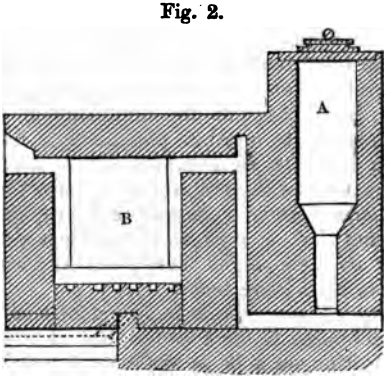


Fig. 3

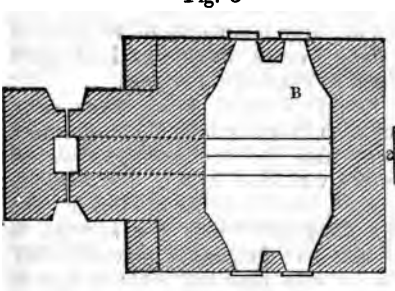
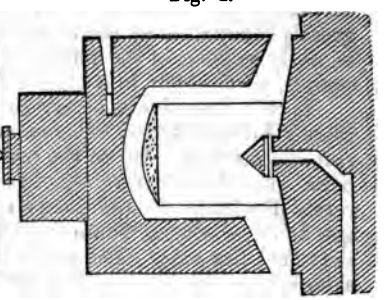


Fig. 4.



arrangement of the apparatus for producing the Sulphuretted Hydrogen. It consists essentially of a pyrites oven or chamber B, and a generator A; the former being charged with pyrites, and the latter with any convenient fuel—but *uncarbonised* if possible. Both charges being ignited, and their volatilised products being brought into contact, Sulphuretted Hydrogen is formed which is carried off into the precipitating chambers.

The production of Sulphuretted Hydrogen by this method is consequently due to the influence of certain gases from the generator on pyrites at a high temperature, the chemical action of which will probably be something as follows:—

As already stated, the generator can be fed with any convenient fuel, but most advantageously with uncarbonised. After many

repeated experiments it has been finally ascertained that by the use of carbonised fuel in comparison with uncarbonised, only an inconsiderable development of Sulpuretted Hydrogen is obtained. This fact leads us to conclude that the distillation-products of the uncarbonised fuel are most efficacious in this process; and that among these products—as we shall show further on—carburetted-hydrogen-combinations form a very powerful agent, as is seen by using ready-prepared tar or pitch in the apparatus.

As a generator with an upward-draught yields a less quantity of Sulphuretted Hydrogen than one with a downward draught, it would appear that free hydrogen contributes essentially to the formation of this gas. It would seem that the steam, or aqueous vapour, produced by the uncarbonised fuel, becomes decomposed in its downward passage through the heart of the fire in the generator with a downward draught, and consequently furnishes more free hydrogen than would be the case from steam given off from the upper part of the fire, which had no opportunity (as in the case of an upward draught) of passing through the heart of the fire. Besides, a downward draught in the generator causes the development of larger quantities of carburetted-hydrogen than would be the case in the ordinary form.

The phenomena observed in charcoal-burning, where more charcoal is obtained by slow than by quick carbonisation, support this opinion; and indicate like conditions in the generator, where a downward draught causes quicker, and an upward draught slower, carbonisation. In the case of the former (the downward draught) the combustible matter arrives in the heart of the blast almost unaltered, and is at once brought within the influence of the high temperature—so that it is suddenly decomposed. By this sudden decomposition combinations seem to be developed distinguished by a large proportion of chemically-combined carbon. The loss in quick charcoal-burning when the temperature of the mounds is raised too rapidly, compared with a slower carbonisation, may be explained by the oxygen and hydrogen being brought into contact with the woody matters so as to form carburetted-hydrogen and carbonic acid instead of water, by which a corresponding quantity of carbon is carried off in the form of gas. The action of the ordinary generator, with an upward draught, is essentially different from this, for the fuel becomes gradually heated by the ascending draught, and is by degrees heated and finally carbonised; so that, when it reaches the heart of the fire, it is already carbonised, and consequently apparently forms different decomposition-products from those that would arise in one with a downward draught. Where the temperature is gradually increased, and the fuel descends slowly, its elements seem to enter into such conditions of affinity, as to result in more water than carburetted-hydrogen or carbonic-acid. By this means, which is analogous to slow carbonisation, we may save that carbon which in the downward draught generator—which is analogous to quick carbonisation—is carried off as carburetted-hydrogen and carbonic acid, as it is in rapid charcoal burning.

Thus the generator produces the following kinds of gases:—

1. *Nitrogen*, derived from the incoming draught.
2. *Carbonic acid*, proceeding from the decomposition of the hygro-

scopic water by the charcoal, and the direct combination of the oxygen with the carbonaceous matter.

3. *Carbonic oxide*, derived from the carbonic acid in its passage through the fire.

4. *Steam*, derived from the undecomposed hygroscopic water of the fuel, and from the combination of the oxygen and hydrogen which are not taken up in forming the carburetted hydrogen and carbonic acid.

5. *Hydrogen*, arising from the decomposition of the hygroscopic water.

6. *Carburetted hydrogen*, derived from the direct combination of the hydrogen with the carbon in the fuel, and from the combinations of carburetted-hydrogen previously existing in it.

Let us now consider the influence of these various gases on the formation of Sulphuretted Hydrogen :—

1. Nitrogen passes over the fire-bridge without any effect.

2. Carbonic-acid likewise seems to have no influence on the pyrites.

3. Carbonic oxide, without having any direct influence on the pyrites or the sulphur-vapour, generally burns on the fire-bridge forming carbonic-acid, and thus acts as the principal fuel in the apparatus.

4. Steam has a doubtful action. Although it has apparently no decomposing effect on the heated pyrites (FeS^2), it certainly has one as soon as the pyrites has become partly decomposed by the loss of a portion of its sulphur, and Sulphuretted Hydrogen and oxide of iron are formed—a result suiting our object. But the oxide of iron thus formed, is apparently again converted into sulphide of iron at the cost of the carburetted-hydrogen already formed—which seems to neutralise the advantage referred to.

5. The portion of the free hydrogen which escapes combustion on the fire-bridge, combines directly with the sulphur-vapour to form Sulphuretted Hydrogen, and hence seems a very important agent in our process.

6. But, to all appearance, carburetted hydrogen seems the most influential agent in our process, for on coming in contact with sulphur-vapour at a certain temperature it seems to be easily and completely decomposed.

From this it will be seen that the more the arrangement of the apparatus is conducted so as to bring considerable quantities of free carbon, and various combinations of carburetted hydrogen, into contact with heated pyrites, the greater will be the results achieved.

Turning now to the application of the Sulphuretted Hydrogen to the precipitation of the copper. This gas, together with the products of combustion, is led into a system of chambers, over which are placed perforated wooden or leaden cisterns containing the copper in solution, which is showered down through the perforations into the chambers beneath. When the copper-solution is thus brought into contact with the Sulphuretted Hydrogen, a precipitate of sulphide of copper is thrown down; this with the rest of the liquid is conducted into a zig-zag channel, where the copper is collected and the liquid afterwards returned to the chamber. This process is

repeated until all the copper is precipitated, and the mother-liquid almost becomes Sulphuretted Hydrogen. After being collected the sulphide of copper is passed through a filter of animal matters—hair or wool—and then washed in order to separate the iron salts. When taken from the filter the precipitate is in a plastic condition; when it is dried either in the air or by artificial heat.

This product contains, according to circumstances, from 20 to 40 per cent. of copper, and is mixed with more or less free sulphur and carbon. When kept in large quantities it is liable to spontaneous combustion; but this is avoided by packing it so as to exclude the air. It can be applied either for the production of copper-vitriol or ordinary copper.

The economy of this process as opposed to cementation does not depend merely on dispensing with iron, but is also advantageous for other reasons. Without entering into these—among which we may name the production of almost chemically pure copper and sulphate of copper—we shall only refer to the result of using pyrites for this purpose.

By this method of producing Sulphuretted Hydrogen the cupriferous pyrites is reduced to a low sulphide without oxidation. Its porous condition after the operation disposes the disintegrated burnt pyrites to oxidise perfectly, when exposed to the air, in a very short time, and to form sulphuric-acid salts; from which the copper can be produced, in the wet way, without much waste. It is acknowledged that the difficulty is, by the ordinary heap-roasting and decomposition, in any degree perfectly to change the copper in the pyrites, into soluble sulphuric acid salts. This is due to the imperfections of heap-roasting generally, but particularly that the sulphuric-acid salts formed during the roasting are again decomposed. The principal object of the roasting is thus destroyed, the extraction of the copper becomes imperfect, and the whole process is economically inadmissible. Under these circumstances a direct smelting of such richer ores becomes preferable; but the treatment of cupriferous pyrites by our process obviates this evil, so that richer ores may be treated in the wet way without leaving too rich residues.

THE CARADON DISTRICT AND MINING INVESTMENTS.—We are preparing a series of statistics, in the shape of a Profit and Loss Account, of the results, during the last fifteen years, of a certain class of Cornish and Devon mines—particularly those dealt in and patronised by the London "market"—which will afford the best evidence of the delusive nature of the system against which we have felt it our duty to protest. The collection of these facts, in the fullness with which we desire to give them, has taken more time than we anticipated; and consequently we are not yet in a position to lay them before our readers.

Abstracts and Reviews.

M. MOISSENET ON THE CORRELATION BETWEEN THE DIRECTION OF METALLIFEROUS VEINS AND THEIR PRODUCTIVENESS.

Etudes sur les Filons du Cornouailles et du Devonshire.—Transport des cercles du Réseau pentagonal au point a^{iv}; directions utiles pour étain, cuivre ou plomb; par M. L. Moissenet. Comptes Rendus des Séances de l'Académie des Sciences.

This memoir promises to open one of the most important questions connected with the theory of metalliferous veins—that is the relations existing between their direction or bearing, their age, and their mineral contents.

That veins in different districts are of different ages is obvious, although it is only under exceptionally favourable circumstances that we can ascertain the age even within wide limits. That in certain given districts the veins belong to various periods is also a well-ascertained fact, and in such cases their *relative* age is easily ascertained although their *absolute* age may be involved in hopeless obscurity. Altogether, however, the age of veins is generally a very obscure subject.

As to the "bearing" or direction of veins, it seems tacitly admitted that, in any given district with veins of various ages, the veins of each distinct period have various and distinctive bearings. But no *general* rule has ever been established, nor indeed seriously suggested, in this respect. In a certain district A we may be assured that all veins having a bearing W. 10° N. are contemporary; but none would be rash enough to attempt to deduce from this any synchronism between these veins and those with a like bearing in another district B.

The relation between the contents of veins and their bearing has hitherto appeared to be equally local. That there exists in certain districts such a relation has long been recognised by practical miners; but as yet all attempts to generalise this experience have signally failed. The empirical rule that holds good in district A has been found wholly inapplicable to district B.

Such seems to us to be the present state of our knowledge on these subjects. It amounts to little more than a confession of absolute ignorance, and many minds chafe against such a confession. They are confident—and in this we quite agree with them—that the deposition of minerals in veins is as much regulated by laws as the movements of the planets; and in their impatience to grasp these laws they are apt to pounce upon any local generalisation that seems at all plausible. Among English metallic miners—particularly in Cornwall—generalisations on the bearing of veins have long been special favourites, for they fall in readiest with their beloved theory that metalliferous lodes originate some how or other with electricity.* The most cursory inquiries however soon show that such generalisations do not hold good even for the county of Cornwall.

* A few years ago it was a fashion to attribute whatever we could not understand to "electricity" or "polar action." As the ideas attached to these words were not very distinct, the practice was generally harmless enough; but with metallic miners—who are rather given to a love of mysticism—it is clung to as a grand unknown cause, hopeless of elucidation, and so far acts as a barrier to real inquiry, just as a belief in the supernatural so long retarded all scientific inquiry. The attributing of cleavage to these causes by so eminent a geologist as Professor Sedgwick gave them at one time a strong position; but it would be well for every one at present to bear in mind that to say metalliferous veins have originated in "electricity" or "polar action" is synonymous to saying we know nothing about them.—Ed.

As far as it is possible to judge of M. Moissenet's Memoir from the abstract given in the *Comptes rendus*, it would appear that his object is to apply M. Elie de Beaumont's celebrated theory on the parallelism and synchronism of the various mountain chains in the world—and their geometrical relations to certain great circles which group themselves so as to form a pentagonal net-work—to the classification and grouping of metalliferous veins.

Although many of our readers may have heard of M. de Beaumont's theory, there are probably few who have taken the trouble of thoroughly understanding it. Indeed it is scarcely possible to do so without a competent knowledge of mathematics, extending at least as far as spherical trigonometry. It is not often that the subject is mentioned in ordinary geological books; but an excellent summary of it may be found in Mr. Hopkin's Address in vol. ix of the "Quarterly Journal of the Geological Society."* Mr. Hopkins being at once a mathematician and a geologist—a rare combination in this country—was above all others fitted to deal with the subject. Without entering into M. de Beaumont's theory, we may say that it was never received with much favour in this country; and, as it is essentially founded on the doctrine of paroxysmal causes—as opposed to Lyellian doctrines—it is certainly not likely at present to receive any greater amount of support. That M. Moissenet should regard the favourite theory of the famous Inspector-General of the Imperial Mining *Corps* of France more favourably, and endeavour to extend its application from mountain ranges to metalliferous veins, is only natural; but this extension will require a full demonstration before it can be received in this country as more than an ingenious and plausible hypothesis.

Taking Cornwall, M. Moissenet enunciates his conclusions in the following propositions:—

"1. *Age of the Schists of West Cornwall.*—The Silurian formation, whose existence in Cornwall was for a long time disputed, is at present recognised by the English geologists on the south-coast where the fossils of the formation have been discovered. *I have found proofs of the presence of this formation in a large part of the peninsula.*" The last sentence, which we have italicised, is a matter of much importance. The great mass of Cornish strata is put down as of Devonian age.† If it can be shown to be Silurian a great step will be made, but the efforts of English geologists, in the absence of paleontological evidence, have hitherto failed to separate it from the Devonian system. We shall consequently look forward with anxiety for M. Moissenet's "*preuves de la présence de cette formation dans une grande partie de la presqu'île.*"

"2. *Granitic Eruptions.*—The granitic masses of Cornwall and Devonshire are attributable to *several epochs of eruption; before that of Dartmoor, several others in the west had been elevated to the surface and been subject to*

* For M. de Beaumont's own exposition of his theory, see D'Aubuisson's *Géognosie*, vol. iii, by Burat, p. 282, Paris, 1835.—*Note sur la correlation des directions des différents systèmes de montagnes.* Comptes rendus, t. xxxi, 1850, p. 325.—*Notice sur les Systèmes de Montagnes*, Paris, 1852.—Compare also Naumann's *Géognosie*, I, 376, (2nd edit.), and Jukes's Manual of Geology, 352, (2nd Edit.)—Ed.

† Compare Professor Sedgwick's paper, "On the Slaty Rocks of Cornwall and Devon, Quarterly Journal Geol. Soc., 1852."

The Professor here states, in which Sir R. Murchison agrees, that "the slate rocks of Cornwall and Devonshire, whatever may be their age, form one connected and inseparable system (except the south-east promontories of the former county, the Dodman, Nare Head, and St. Anthony's Point)." To this he reserves one possible exception—the great spread of slate rocks between Bodmin and the mouth of Padstow River, where Sir R. Murchison conjectures that Silurian rocks may be elevated into *the sterile ridges* called Pydar Downs.—Ed.

modifications." This is also to some extent a new doctrine. Although not considered as absolutely synchronous, the granite protrusions of the Ocrinian chain have hitherto been held to belong to one great period. It is not clear in the abstract, what intervals M. Moissenet would place between the "*plusieurs époques d'éruption;*" but if the western granitic masses had been raised and denuded before the elevation of Dartmoor, it is clear that greater intervals must have elapsed between the elevation of the various granite masses of Cornwall and Devon than English geologists have hitherto been prepared to admit.

"3. *Directions observed in Cornwall.*—As long ago as 1857, I reduced the directions of the great circles corresponding to the nineteen old systems, to point a^{lv} of the net-work (lat. N. 50° 25′ 46″; long. W. 8° 10′ 17″).*

Studied on the spot, with the maps of the Geological Survey, they enabled me to understand not only the general configuration of the surface, but also the phenomena bearing on the mechanical origin of veins—that is their original formation, the subsequent preparation of fissure, and its epochs of filling and re-opening."

"4. *System represented by the great primitive circle of the Land's End-Apscheron.*—I have ascertained that this great circle is the exact representative, at least for the country under consideration, of the as yet undetermined elevation between the Devonian and Carboniferous periods.

"5. *Octahedric of Mulehacen.*—This circle, whose intersection with the preceding one determines my centre of reduction (a^{lv}) has a considerable influence in several districts and most especially explains the apparent anomalies of the lodes of St. Just."

"6. *Special importance of the eleven old Systems* (from that of Vendée to that of the Rhine, including the Land's End).—These systems have a preponderating influence on the formation of the veins in Cornwall, *where they are all recognisable.*"

The four latter propositions enunciate M. Moissenet's special views on Cornwall. He takes the primitive circle of the Land's End (bearing, with respect to point a^{lv}, W. 8° 23′ 9·85″ S.) to be the main elevating axis, which is crossed at right angles by the Octahedric of Mulehacen. Besides these main great circles, the ten other great circles of the old Systems, down to that of the Rhine inclusive, he also considers to be *all recognisable.* The bearing of these, reduced to point a^{lv}, are as follows—classing separately those bearing nearly East and West from those bearing nearly North and South: W. 21° S. (Finisterre), W. 26° N. (Morbihan), W. 40° S. (Westmorland), W. 5° N. (Ballons), W. 15° S. (Netherlands); N. 26° W. (Vendée), N. 20° E. (Longmynd), N. 23° W. (Forez), N. 8° W. (North of England) and N. 10° E. (Rhine).

But besides this general application of M. de Beaumont's theory to the explanation of the origin of metalliferous veins, M. Moissenet goes much further. He believes he can not only apply the theory generally, but also in such detail as to be practically applicable—so that "the discovery and working of our mineral lodes may be carried on with certainty." We are very far from hoping such an application to be possible; but as the present abstract gives only the author's *conclusions*, and not the facts or reasonings on which the conclusions are founded, we must be content to wait until we receive the latter before we can form an opinion as to the weight of the evidence he can adduce in support of so bold a statement.

The following are M. Moissenet's propositions on these subjects:—

"7. *Influence of the bearing on the nature and richness of veins: its degree.*—Not only do we observe this influence in the *ensemble* of the observed bearings of groups of veins, but we also see its special influence

* Which corresponds to a point in the centre of Cornwall.—ED.

in each metalliferous district, *and in the successive bearing which each vein takes.*"

"8. *Bearings usefully workable for tin, copper or lead.*—As a practical consequence, the study of this influence enables us to discover the rich parts of a vein and to distinguish them from the sterile portions or at least those too poor to be usefully worked."

Referring to Captain Charles Thomas's views on this subject, M. Moissenet points out, that—starting from entirely opposite points of view, Captain Charles Thomas being without any theoretical preconception—they arrive at what may be practically be regarded as the same results. But beyond Captain Thomas's statements, which are merely the generalisations of the facts observed in his own district, M. Moissenet goes further. "I shall show that for each district we may narrow the actual limits of experience, and that we may usefully follow the action of the systems even into the details of the vein, including its relations with its neighbouring veins and faults ..... Not only will the lines calculated serve to trace and connect the great formations, or mineral deposits, distant from each other, but in each metalliferous district they are shown so clearly, that with prudence and discernment miners will be able to find in them a certain guide, which they have hitherto wanted, and without which they have had but the gropings of experience and the chances of their own natural judgment."

If these propositions can really be established, M. Moissenet will have succeeded in taking the most important advance yet made in our knowledge of metalliferous veins; but until we can see the proofs we must be permitted to doubt it. M. de Beaumont's theory, upon which the whole superstructure is based, is decidedly repugnant to the principles of geology now generally received, for it assumes all mountain chains to be formed by forces which were in action, in one direction, simultaneously all over the world. All recent geological investigations favour the opposite view, which is, that these forces acted locally, over moderate areas only, and intermittingly. If we consider metalliferous veins to have somehow originated in connection with these forces—which is not in itself improbable—the relation between their bearing and date could only apply *generally* on the hypothesis of M. de Beaumont. On the theory that the elevatory forces only acted locally, any *general* correlation between their direction and date becomes impossible. For this reason, although we believe that *local laws* of great practical value and importance remains to be elucidated, we very much doubt whether any *general laws* between the bearing of veins and their productiveness will ever be established.

Although we venture to doubt M. Moissenet being able to make good the propositions announced in the abstract, we shall look forward to the paper itself with much interest. It is certain to be one of great importance if even the author fails to establish his propositions; and under any circumstances we are much indebted to him for the ventilation of the subject.

ON THE SEPARATION OF TIN FROM ANTIMONY, AND ON THE ANALYSIS OF THE ALLOYS CONTAINING LEAD, TIN, ANTIMONY, AND COPPER.

By Charles Tookey, F.C.S.,

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(Abstracted from the *Journal of the Chemical Society.*)

The separation of tin from antimony, with a view to their direct quantitative estimation, has hitherto been regarded as an analytical process involving considerable difficulty, on account of the similarity which exists in the behaviour of the compounds of those metals with reagents.

The method *proposed by Gay Lussac* consists in precipitating the tin

and antimony together by means of a strip of zinc; the weight of the precipitated metals having been ascertained, they are then redissolved in nitro-hydrochloric acid, and the antimony separated from the diluted solution by a strip of tin, the amount of this metal originally associated with the antimony, being estimated by difference. The more recent method, by Rose, provides for the direct estimation of each metal, the separation being effected by fusing the oxides with hydrate of soda, and digesting the antimonate and stannate of soda produced, with diluted alcohol, the insoluble antimonate of soda being afterwards washed on a filter with alcohol of increased strength as the operation of washing approaches completion.

Having had occasion to examine some alloys containing lead, tin, and antimony, with small quantities of copper, and having failed to obtain sufficiently accurate results in the separation of tin from antimony by either of the processes mentioned, I made several attempts to effect the object in view, but without success, when the reaction between the sulphides of tin and antimony and hydrochloric acid (gas) occurred to me as likely to afford a method free from objection.

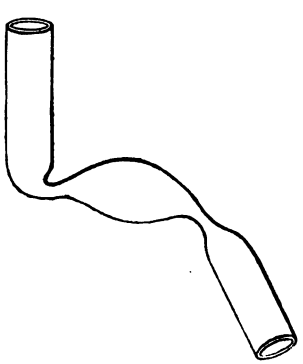
When tersulphide of antimony is exposed to the action of hydrochloric acid (gas), decomposition is effected at the ordinary temperature, with production of sulphide of hydrogen and terchloride of antimony, which, when gently heated, is easily volatilized in a current of the gas. Proto-sulphide of tin, when treated in a similar manner, is also decomposed, the products of decomposition being sulphide of hydrogen and proto-chloride of tin, which may be heated to incipient fusion in an atmosphere of hydrochloric acid, without undergoing any further change. A necessary condition, therefore, to the success of a separation by means of the reactions just stated, would be that the tin should exist in solution in the state of protoxide. By the method of analysis to be further described, the tin was obtained in the state of bichloride, and in endeavouring to effect the reduction of the bichloride to the state of protochloride, an experiment was made to ascertain the action of metallic iron upon the mixed chlorides of tin and antimony, in presence of an excess of hydrochloric acid, the result of which was, that while the bichloride of tin was reduced to protochloride, the whole of the antimony appeared to be separated in the metallic state.

Gmelin states, on the authority of Fischer, that iron does not precipitate tin from the protochloride at the boiling heat. To see how nearly separation could be effected by iron in the presence of hydrochloric acid, 6·03 grs. of pure antimony, and 4·16 grs. of tin were dissolved in hydrochloric acid, with addition of a few drops of nitric acid; the solution was diluted with water, and, after adding more hydrochloric acid, digested at a gentle heat with 15 grs. of thin sheet iron, until the whole of the iron was dissolved; a considerable quantity of cold water was then added, and the antimony collected on a weighed filter, after being washed with water and and dried, the antimony weighed 6·02 grs. In a second experiment, 9·145 grs. of pure antimony and 1·065 grs. of pure tin were dissolved as before; the antimony in this case after drying weighed 9·18 grs., the tin was precipitated from the filtrate by sulphuretted hydrogen, the proto-sulphide of tin dried, and converted into binoxide by careful ignition, the amount of binoxide obtained was 1·36 grs., containing 1·069 grs. of metallic tin.

In the analyses of the alloys containing, lead, tin, and antimony, with small quantities of copper, the ordinary method for separating tin and antimony from other metals was used, viz., oxidation with nitric acid, the action being promoted by heat, and the excess of acid expelled by evaporation, the nitrates of lead and copper were removed by washing on a filter with hot water. By proceeding in this manner it was found, in two analyses of the same alloy, that the amounts of lead, and also the collective

weights of the oxides of tin and antimony differed to a considerable extent. The same discrepancy was observed, whether the acid used for oxidation was in the concentrated state, or previously diluted with water. In order to ascertain the source of error, the oxides of tin and antimony were examined, and found to contain oxides of lead in a state of combination, in which it could not be separated by washing with water, and to see whether the application of heat affected the result, two equal weights (10 grs.) of the same alloy were taken, one was treated in the usual manner, heat being applied to promote the oxidation by nitric acid, the excess of acid being expelled by evaporation; boiling water was then added, and after perfect washing, the mixed oxides weighed, on ignition, 8·92 grs. The other was oxidized by nitric acid, without the application of heat, and the resulting oxides weighed 7·31 grs. The application of heat causes therefore a large proportion of the lead to remain with the oxides of tin and antimony. When an alloy of lead and antimony is heated with nitric acid, the latter metal is converted into antimonic acid, which combines with the oxide of lead, the resulting compound being insoluble in water.

That the whole of the lead might be separated from the other metals, the following process was employed. The alloy was oxidized by nitric acid, but little more acid being used than was necessary for oxidation; after removing the excess of acid by evaporation at a low temperature, the residue was digested with hot water, the oxides of tin and antimony being collected on a weighed filter, and after perfect washing, dried at 110—120° C. After ceasing to lose weight, they were carefully transferred to a glass boat; the filter with the small portions of oxides still adhering to it was again dried and weighed, the difference between the two weights giving the amount of oxides operated upon. The boat was then placed in a condensing apparatus, through which a slow current of hydrochloric acid was transmitted, and when the contents of the boat had become liquid from the absorption of gas, a gentle heat was applied in order to distil over the chlorides of tin and antimony. When the distillation was nearly finished, a greater heat was used to expel the last traces of bichloride of tin, and, the tube having cooled, the boat was withdrawn, and its contents (chloride of lead) dissolved out, and added to the solution containing the nitrates of lead and copper. These two metals were determined as usual, the solution being evaporated nearly to dryness, with a slight excess of sulphuric acid, and the sulphate of lead washed with water acidified with sulphuric acid, and the oxide of copper precipitated from the filtrate by a solution of potash. The chlorides of tin and antimony were poured into a small beaker; the apparatus rinsed out with dilute hydrochloric acid, and, after adding more hydrochloric acid, the solution was heated gently and digested with metallic iron (as pure as possible) until the whole of the iron had dissolved, cold water was then added, the antimony collected on a weighed filter, and after washing with cold water, dried at 110° C. The filtrate from the antimony, if not sufficiently dilute, was mixed with water, and then saturated with sulphuretted hydrogen. The sulphide of tin being afterwards converted into binoxide by ignition.



In order to simplify the process as much as possible, the following plan was eventually adopted. Ten grains or more of the alloy to be analysed were introduced into a small piece of apparatus, having the following form, sufficient nitric acid to complete the oxidi*dation was poured upon* the alloy by means of a funnel-tube;

the end *a* was corked, and the oxidation effected at a moderate temperature. When the alloy had been converted into a perfectly white mass, the excess of acid was expelled by attaching a tube and cork to *a*, and causing a gentle current of air to traverse the apparatus, either by means of an aspirator, or a pair of bellows; during this operation the apparatus should be heated sufficiently to cause the evaporation of the excess of nitric acid. The end *a* was now connected with an apparatus for generating dry hydrochloric acid (which should be made from fused chloride of sodium and sulphuric acid), while the end *b* was immersed in a small quantity of water contained in a beaker; the remaining part of the operation may be conducted as in the former process, care be taken not to distil the volatile chlorides too rapidly, and to avoid the fusion of the chloride of lead until all the bichloride of tin has been expelled.

The iron employed to precipitate the antimony should be in the form of thin sheet, about three times the weight of the antimony present, being usually sufficient for complete precipitation. It is necessary that the flask for generating the hydrochloric acid be provided with a funnel-tube, dipping just below the surface of the fluid, in order to prevent the too rapid absorption of the gas by the water which is used to condense the chlorides of tin and antimony.

THE BOARD OF TRADE RETURNS.

The "Accounts relating to Trade and Navigation of the United Kingdom, for the month ended 31st October, 1862, and ten months ended 31st October, 1862," have been issued by the Statistical Department, Board of Trade.

IMPORTS.—The imports of metals and metallic ores for the month and ten months ended 31st October, have been as follows:—

	Month ended 30th September.		Nine Months ended 30th September.	
	1861.	1862.	1861.	1862.
Brimstone .. .. cwts.	179,032	56,938	724,887	901,378
Copper Ore .. .. tons	4,786	2,674	62,939	66,559
Copper Regulus .. „	513	3,019	16,264	28,821
Copper, unwrought and part wrought .. cwts.	37,740	10,100	225,760	216,480
Iron, in Bars, unwrought tons	3,800	5,423	27,951	33,182
Steel, unwrought .. „	584	350	2,917	3,536
Lead, Pig and Sheet .. „	1,846	2,397	15,835	17,705
Spelter or Zinc .. .. „	1,298	2,180	16,821	14,696
Tin, in Blocks, Ingots, Bars, or Slabs .. cwts.	9,712	4,186	44,864	62,459
Silver Ore .. value in £	1,230	51,050	210,978	269,838
Quicksilver .. .. lbs.	119,719	401,311	1,823,339	833,449

Comparing the imports of these articles during 1861 and 1862, the only changes to be remarked are—an *increase* in silver ore of 49,820*l.* worth during the month, and of 58,860*l.* during the ten months. Brimstone shows a decrease during the month, but an increase during the ten months; in tin in blocks there is also a decrease during the month, with an increase during the ten months. Quicksilver shows a large increase during the month, but a very large decrease during the ten months.

EXPORTS.—The quantities and declared value of the exports of metals, minerals, and metallurgical articles of British and Irish produce and manufactures, for the month, and ten months ended 31st October, have *been as follows*—

	QUANTITIES.				DECLARED VALUE.			
	Month ended 31st October.		Ten Months ended 31st October.		Month ended 31st October.		Ten Months ended 31st October.	
	1861.	1862.	1861.	1862.	1861.	1862.	1861.	1862.
					£	£	£	£
Alkali: Soda .. .. cwt.	138,750	154,762	1,138,052	1,765,698	58,299	65,520	493,931	747,769
Coal, Cinders, and Culm .. .. .. tons.	836,246	680,698	6,837,862	7,134,621	382,798	305,536	3,127,630	3,197,921
Iron, Pig and Puddled .. .. .. ,,	43,598	32,165	336,417	385,316	121,825	90,145	908,438	1,038,501
Iron, bar, Angle, Bolt, and Rod .. .. ,,	23,598	24,061	215,933	251,355	179,160	182,769	1,574,626	1,840,150
Railroad Iron, of all sorts .. .. .. ,,	27,384	33,257	341,403	343,204	214,756	246,235	2,628,060	2,379,842
Iron Wire .. .. ,,	970	1,310	10,218	10,702	18,435	26,880	180,424	232,343
Iron, Cast .. .. ,,	9,298	3,872	63,291	52,068	85,507	36,109	585,427	455.847
Iron Hoops, Sheets, and Boiler Plates .. ,,	8,871	9,185	70,802	86,047	89,065	85,113	720,570	844,564
Iron, wrought, of all sorts .. .. ,,	10,643	15,217	96,233	111,453	190,988	260,937	1,687,206	1,851,062
Iron Steel, unwrought .. .. .. ,,	2,162	1,147	18,133	21,252	73,203	38,420	597,399	688,924
Copper, unwrought in Ingots, Cakes or Slabs .. .. cwt.	5,451	7,924	76,861	88,254	27,108	38,973	383,082	430,861
Copper, wrought, or partly wrought, Bars, Rods, Bottoms, Pans, Plates, Sheets, and Nails; and mixed or Yellow Metal for Sheathing .. ,,	26,593	36,660	251,525	350,361	126,278	171,344	1,202,390	1,637,616
Copper, wrought, of other sorts .. .. ,,	8,304	2,096	41,313	23,304	46,604	13,290	235,825	140,498
Brass of all sorts .. .. ,,	3,498	2,389	24,841	31,224	17,981	14,258	137,542	169,987
Lead, Pig, Rolled, Sheet, Piping, Tubing, and Lead Shot .. .. .. tons	2,088	3,749	16,282	29,818	45,035	78,611	359,629	630,914
Lead Ore, Lead, Red and White and Litharge of Lead .. .. ,,	527	355	4,920	6,744	12,696	8,532	125,682	152,791
Tin, unwrought .. .. cwt.	3,940	5,788	49,163	71,657	23,123	33,569	298,958	414,825
Tin Plates .. .. ,,	—	65,312	—	881,892	80,971	80,491	736,216	1,062,455
Zinc or Spelter, wrought or unwrought .. ,,	7,308	8,099	77,517	77,837	7,583	8,284	84,265	78,804
Salt .. .. tons	66,231	53,875	621,135	568,610	33,108	26,157	330,299	274,144

Comparing the value of the exports of these articles during 1861 and 1862, we have the following results:—

FOR THE MONTH ENDED 31st OCTOBER.—During this period of the present year, the total value of exports has been 1,811,176*l.* against 1,834,523*l.* during the same period of 1861, showing a *nett decrease* of 23,347*l.* On the separate articles enumerated, the respective increase and decrease has been as follows:—

Increase.—Alkali, 7,221*l.*; iron (bars, &c.), 3,609; railroad iron, 31,479*l.*; iron wire, 8,445*l.*; iron (wrought), of all sorts, 69,949; copper (unwrought), 11,865; copper (wrought or partly wrought, bars, &c.), 45,066*l.*; lead, 33,579*l.*; tin (unwrought), 10,446*l.*; and zinc or spelter, 701*l.* Making a total gross increase of 222,360*l.*

Decrease.—Coal, cinders, and culm, 77,262*l.*; iron (pig and puddled) 31,680*l.*; iron (cast), 49,398*l.*; iron hoops, sheets, &c., 3,952; iron steel (unwrought), 34,783; copper (wrought) of other sorts, 33,314; brass, 3,723*l.*; lead ore 4,164*l.*; tin plates, 480*l.*; and salt, 6,951*l.* Showing a total gross decrease of 245,707*l.*

FOR THE TEN MONTHS ENDED 31ST OCTOBER.—During this period of the present year, the total value of exports has been 18,269,831*l.*, against 16,397,629*l.* during the corresponding period of 1861, showing a *nett increase* of 1,872,192*l.* On the separate articles enumerated, the respective increase and decrease has been as follows:—

Increase.—Alkali, 253,838*l.*; coal, cinders, and culm, 70,291*l.*; iron (pig and puddled), 130,063*l.*; iron (bars, &c.), 265,524*l.*; iron wire, 51,919*l.*; iron hoops, sheets, &c., 123,994*l.*; iron (wrought), 163,856*l.*; iron steel (unwrought), 91,525*l.*; copper (unwrought), 47,779*l.*; copper (wrought, or partly wrought, bars, &c.), 435,226*l.*; brass, 32,445; lead, 271,285*l.*; lead ore, 27,112*l.* tin (unwrought), 115,867*l.*; and tin plates, 326,209*l.* Showing a total gross increase of 2,406,933*l.*

Decrease.—Railroad iron, 248,218*l.*; iron (cast), 129,580*l.*; copper, (wrought), of other sorts, 95,327*l.*; zinc, or spelter, 5,461*l.*; and salt, 56,155*l.* Showing a total gross decrease of 534,741*l.*

A NEW THEORY ON THE FORMATION OF THE METALLIFEROUS VEINS IN THE NORTH OF ENGLAND.

We have received from Mr. John Curry, of Boltsburn, Eastgate, a paper "On the Throws, Hades, Shifts, and other important Phenomena of the Metalliferous Veins of the North of England." The paper is in many respects valuable, for it contains several important statements of facts; but unfortunately these facts are encumbered with, and pressed into the service of, a theory which is rank geological heresy—and which consequently we cannot admit into our leading pages. That Mr. Curry's theory is really of this character, the following extract will abundantly prove:—

"The theory about to be advanced is based on the following assumptions;

'1. That internal heat, in vast quantities, has been transmitted through the crust of the earth, and more energetically through the protuberant parts, especially at and near the primary axes of mountain chains.

"2. That the heat has been transmitted in the greatest quantity in early periods and afterwards diminished through succeeding eras.

"3. That the fissures in the primary rocks and the fissured-like structures built up into later formations have been the principal channels for its transmission.

"4. That the heat so transmitted has produced *numerous complex marine currents, which have been the chief agencies concerned in producing the hades, throws, shifts, &c., of metalliferous veins.*

"It has very often been considered that the sedimentary strata were originally deposited in the ocean in continuous and horizontal sheets, and were afterwards elevated and broken up from their solid aggregated state into dislocated masses, by some powerful expansive internal force. The veins have also been generally regarded as true fissures.

"Under the present theory, *the sedimentary strata are viewed as being laid down, with few exceptions, in all the varied forms of corrugation, dislocation, &c., as we actually observe them.* Neither are the veins looked upon as true fissures, *but as fissure-like structures, built up contemporaneously with the strata* and commencing from what might be true fissures in the primary and deep seated rock. I will, however, here assume some primary or deep-seated fissured rock, whereon to build the superincumbent formations of sedimentary strata, without entering into the nature of the force and its mode of operation in effecting such fissures."

Applying this theory to elucidating the formation of the veins of the North of England, Mr. Curry assumes the existence, in "the primary or deep-seated rock," forming the bed of the ocean where sediments are being deposited, of a straight open fissure of uniform width; and admitting "that this rock is the medium for transmitting heat from a considerable depth in the crust of the earth to the bottom of the ocean, then"—Mr. Curry holds—"it necessarily follows that much heat must be given off into the fissure." This heat causes "lateral movements" in the water; and the velocities, variability, or constancy of those currents so affect the strata in course of deposition that a straight vein with even sides or cheeks—or a crooked vein with uneven cheeks—will result according to the variability of these conditions. Where the fissure in the "primary rock" was irregular, of course the vein built up on it might *a fortiori* be still more so. He thus accounts for the varying size and irregularities of veins.

The "throws" of the strata adjoining veins he explains by the following hypothesis:

"Assuming an oblique fissure in the deep-seated rock, while the fissure remains open the water which is heated in it and sent out upwards into the ocean, must be replaced either by water percolating through the rock and entering the fissure along with the heat, or by going from the top downwards, thus causing up and down currents. Under such circumstances, the current of heated water will take a direction, deviating somewhat from the perpendicular. The rising of heated water from the top of the fissure would not only be opposed to the falling of the sediments where they occurred, but would gather and carry them upwards and away to the right. The ascending motion would be most accelerated near the top of the fissure, and would gradually decrease upwards as the heat became more diffused in the ocean, until it would ultimately cease. Then the sediment so gathered and raised would be left at liberty to fall. From these circumstances, it appears evident *that more sediment would fall on the bed of the ocean to the right or underlying side*, of the fissure. This being the case, it is also further evident that the underlying side would build up somewhat faster than the overhanging one, and of course would attain a higher level after a period of continued deposition. This higher level of the underlying side is in accordance with a very general law respecting metalliferous veins. To exemplify this part of the subject, and convey an idea how very small and almost inappreciable causes may produce very significant and important results, by continued action through a lengthened period of time, I may take the building up of the alternating strata of limestones, sandstones, and shales, of the lead measures, to the thickness of one hundred fathoms. Let the building up be supposed to commence from the top of the Great Whin Sill, where oblique fissures are giving out heat, and let the ratio of thickening of the beds, on the underlying side of each fissure, be one-fourth, one-half, three-quarters, and one inch, in one fathom, then the respective differences

of level, or throw of the strata, when the building up of one hundred fathoms had been accomplished, would be two feet one inch, four feet two inches, six feet three inches, and eight feet four inches. These differences of levels, or throw of the beds, seems to have a close correspondence to the actual throws of the principal bearing veins of the district. The strata, wherein the veins have yielded the richest deposits of lead-ore, are the Great Limestone, Coal Sills, Little Limestone, and some other adjoining strata. This productive part of the lead measures ranging some one hundred fathoms above the Great Whin Sill is where the mining operations have been most extensive, and, of course, where observations have been most frequently made on the throws and shifts of the veins, and on the bent positions, &c., of the strata in their vicinity. According to this, then, the throws and shifts of veins, and the bent positions of the strata in their vicinity, must, in general, necessarily decrease downwards and *vice versa*.

"And if the above very small additional deposits to the underlying sides of the fissures will occasion in the building up of one hundred fathoms throws equivalent to those that actually occur, how much smaller may be the additional deposit when the building up commences from deeper and more primary rocks?"

The well-known phenomena of the distortion or bending of beds on their approach to faults—rising towards the upthrow and dipping towards the downthrow—is similarly explained; from which Mr. Curry next proceeds to explain, on his theory, the hade of veins, and the reasons for their greater hade in argillaceous than other strata.

"Let us take the case of an argillaceous stratum with a vein having a capacity for carrying heat from below upwards. It is very probable that veins take the directive tendency of their hades from and in accordance with the original fissure. For example, if the vein commence to build from an oblique fissure having that direction it will hade over to the right at the top; whereas another vein, constructing from a fissure, having a contrary obliquity, will hade over to the left. But a vein which builds from a perpendicular fissure, will in all probability continue upwards without much hade. This will, however, depend upon circumstances. The argillaceous, or plate sediments, being finer and lighter than the sandy ones, the force of escaping internal heat, consequently, has more control over the former than the latter, while deposition is going on. The internal heat will find its way through the plate bed upward, and will be manifested with much energy at the top of the thrown up cheek. Here this force will drive the loose light unaggregated particles back, and cause the surface of the aggregating mass to form and lie back from the perpendicular, often at a considerable angle. The depositing particles on the down cheek will be drawn onwards and upwards so as to cause the aggregating surface of this cheek, or side of the vein, to build up with much conformity to the opposite cheek, hence the greater hade in argillaceous strata than in either sandstones or limestones. Though these conditions, just described, might give considerable hade while the argillaceous deposit continued, yet, a change would occur when the next stratum, supposing it to be sandstone, began to be laid down. The arenaceous sediments being heavier than the argillaceous, of course the power of escaping heat could not be so effective in forcing them back, therefore they would construct nearer perpendicular."

Mr. Curry having thus, to his satisfaction, accounted for the irregularity and hade of veins, and also the throws and distortion of the strata in their neighbourhood, proceeds to grapple with the shifts or heaves of the veins themselves. To any one acquainted practically with the heaves of veins in all their variety nothing could seem more hopeless; but Mr. Curry faces the matter boldly, and endeavours to account for them by the following explanation.

"We now turn our attention to the shifts. I have shown that the

strong north and south vein does not shift the east and west one which crosses it at right angles, but that it shifts those which cross it obliquely. The north and south veins generally have most throw, and frequently shift those of an east and west character; they are also more wreathed in their appearance, and can often be traced to a good distance on their line of bearing. It would appear from the properties of the north and south veins that they have given off more heat during building up, than those approximating an east and west course. The greater the quantity of heat given off, during the building up of a vein along with the strata, the more energetic would be the motion of oceanic water towards the vein. When veins are beyond the reach of each other's influence, the movements, or currents, will generally set in to them at right angles; but when they come within this influence, the currents of one or both the veins will be deflected from their right angled course. Then, the north and south vein, being a powerful one, and bringing a vast quantity of heat from the interior to the surface of the solid crust, at the bottom of the ocean, the water will be drawn to it on each side with more rapidity, and from a greater distance, than it will on the sides of the east and west veins, therefore, the currents up to the side of the east and west vein, will be deflected. This will necessarily weaken the forces of the water up to the east and west vein so far as the influence of the north and south vein extends. Though the forces be weakened, and their direction deflected, yet, being equally so on both sides of the east and west vein, it will not sensibly deviate from its rectilineal course, But this is not the case where the veins intersect each other obliquely. Say where a vein from the north of east intersects the north and south vein on the eastern side. It is then shifted to the south, for the following reasons:

"The shifts, like the throws, are considered as being effected contemporaneously with the deposition of the veins and strata, and as commencing at a certain depth in the earth at the top of the original fissure, and generally increasing upwards. When the veins began to build up from the original fissures, the oblique vein would have no shift. By assuming the fissure representing the north and south vein to hade from the perpendicular downwards to the west, and that representing the oblique vein, to the north or north west, it is highly probable that these hades will continue while building up, and that the former would throw the east side up, and the latter the south, or south-east one, in agreement with a very general law relative to veins and faults. In the case under consideration, the reciprocal influence of the veins is undoubtedly very marked for a considerable distance on each side of the intersection, but most so near the point of crossing, and gradually diminishes therefrom till such influence ceases, and then the currents to each vein will go up at right angles as previously remarked. That part of the vein, on the east side of the north and south vein, will draw the cold water up to its south-east side or cheek, but on the north-west side, the water, as soon as the influence of each vein reaches one another, will move moderately slanting at first, and then gradually increase along this side to the angle of the intersection. This will also be the case on the east side of the north and south vein from the point where the veins begin to affect each other to the angle of intersection. Assuming the distances shifted as equal to two fathoms each, then the total shift will be four fathoms.

"Supposing such a shift to be accomplished during the building up of one hundred fathoms of strata, it would only require the vein to change its place of coalescence along the east side of the north and south vein at the rate of something less than three quarters of an inch during one fathom of building, and the same for the west side."

Differing *in toto* from Mr. Curry in his conclusions, and having no opinion whatever of his theory, we have yet thought it well to give an

abstract of his ideas. The opinions of practical miners on geological subjects are often of the most extravagant character, but still they not unfrequently possess a certain amount of consistency and plausibility; and it seems to us very useful that it should be known what these opinions are.

In Cornwall and Devon the prevalent opinion is that lodes originated by some mystic influence of electricity or polar action wholly undefinable; and the popularly received geological principles are those of Mr. Evan Hopkins, who maintains that the surface of the earth is gradually moving northward and being swallowed up at the north pole while new lands are emerging from the south pole. The West loves high-sounding mystic hypotheses, and decidedly objects to the detail of modern geology. We once met with a most striking and amusing instance of this in the case of a very prolific writer in the *Mining Journal*—a "Practical," who is never tired of denouncing the "theories" of Murchison, Lyell, or Sedgwick, and who specially disapproves of all the Jermyn-street proceedings. This great denouncer of theories, and despiser of geological books, made however one exception—and that was Whiston's New Theory of the Earth, which he had picked up at some old book-stall! This was a volume he rarely separated from, carrying it through all his journeys; and we remember when he showed it to us he particularly directed our attention to a beautiful description of chaos—illustrated by a plate, if we recollect rightly. And it must be borne in mind that this is a very shrewd and clever man—a man whose judgment on most subjects, barring geology, we should at any time be anxious to have.

The theories of the metallic miners in the North, as far as our experience goes, are of a different character. They are less shadowy, and even when incorrect are intelligible. This is the case with that of Mr. Curry, who in his reasonings and illustrations shows a clear head—one worthy of being applied to a better purpose. The fact which seems principally to impress him, and which indeed may have suggested the theory to his mind, is that, as a rule, almost all faults or throws traceable in connection with metalliferous veins gradually *decrease in depth*. This is a fact that has scarcely received the attention it deserves; and it would seem to show that such disturbances are due rather to the subsidence of the downthrow side than the elevation of the upthrow.

ON THE MINES, MINERALS, AND MINERS OF THE UNITED KINGDOM.

By ROBERT HUNT, F.R.S., KEEPER OF MINING RECORDS, ROYAL SCHOOL OF MINES.

(Read before the Society of Arts, December 17, 1862.)

THE mineral treasures of the United Kingdom are in every way remarkable. Whether we examine the subject historically, commercially, or from a scientific point of view, it is equally full of that real interest which ever surrounds those things which minister directly to the necessities and luxuries of human existence. For more than two thousand years we have been a mining people. The history of British mining is a remarkable exemplification of the constantly renewing energies of man, applied without any other guiding light than that of undisciplined experience, to the discovery of mineral wealth. It shows us that each age has, in its own particular way, been digging into the earth—that in so digging some knowledge, curious and valuable, has been acquired; and it instructs us further that the miner died—that his experience perished with him—and that the son had to commence where his father began, and that, unfortunately imbued "by what it works in like the dyer's hand," he held his acquired knowledge as too sacred a thing to endure the light, and

bequeathed darkness and mystery to his child. In this way we have laboured, producing from the limited area occupied by the British Isles, a larger amount of metallic wealth than has been yielded by all the world beside. This is due to the industry of the people—to that irrepressible energy, which, like a mighty pulse, has varied in intensity of action, but which has never ceased to beat and quicken the life-labour of England's sons.

Back in those dark days, where the guiding light of History has not penetrated—where we are aided alone by the uncertain flickerings of wild traditions—British mining had its origin. The Tyrian navigator, in all probability reached these shores, and traded with our forefathers for the tin which was employed in the manufacture of those bronzes which were so prized by the ancient monarchies of the East, and which now are prized as antiquities in our own museums. It is true this is doubted by one of our high authorities. But Sir George Cornwall Lewis, in his "Astronomy of the Ancients," has only opened a door which he has found himself unable to close, and he has left the subject of our commerce with the Phœnicians in a sadly disturbed and most unsatisfactory state. The evidences of mining, by that people whom we usually distinguish as the ancient Britons, it must be admitted, are obscure. I have, however, pursued the enquiry for more than twenty years, and have never lost an opportunity of examining any work assigned by tradition to the pre-Roman period, and I feel assured of the existence of the rude works of a rude people, to which I can now point as satisfactorily indicating the labours of our British forefathers.

The Roman mines in Cardiganshire, in Shropshire, and some other counties, show us that the followers of Julius Cæsar sought with great industry to render the natural treasures of Britain available for useful ends. The inscribed pigs of lead, and ingots of copper, which have been discovered and preserved, acquaint us with this, and prove the Romans to have been not only successful miners but skilful metallurgists. From the departure of the Romans, after their four hundred years of occupation, we have no reliable evidence of the progress of British mining for upwards of five centuries.

It is, however, certain that mining operations must have been prosecuted during this period, as we find the tinners of Cornwall and Devon of sufficient importance to obtain from King John, in the third year of his reign, a charter granting them especial, indeed tyrannical, privileges.

Presuming, it would appear, upon the patronage bestowed on them, they assumed to themselves extraordinary powers. We find a petition to Parliament, in the first year of the reign of Edward I., asking for protection from the incursions of the miner, stating "The said tinners do daily dig and claim to dig in every species of land, as well in tilled as in other lands, and destroy houses, meadows and woods, and divide and turn the course of water, running as well to mills as elsewhere, throughout the whole country, to the great destruction and dispersion of the said commonalty."

At a later period several of our monarchs gave every encouragement to mining operations, and Queen Elizabeth persuaded many German miners to come to this country, to whom she granted free right of search for minerals over the most important mining counties. The purpose of that Queen was to introduce a better system of exploration than that which then prevailed. From this period, the progress of our mineral industries is tolerably well defined, and we may record a steady advance in the rate of production, until we find the value of our metals and minerals, exclusive of building stones and clays, to have been in 1861, 34,602,853*l.**

* "Mineral Statistics," by Robert Hunt.

The thoughts of men, therefore, have been turned to the mineral conditions of these islands for more than two thousand years. In that period the art of mining has improved; and the engineering appliances which have been brought to bear upon the ventilation and the draining of mines, are fine examples of mechanical ingenuity. The science of mining, however, can scarcely be said to have, as yet, an existence. In 1856, Mr. John Taylor, who must be regarded as a good authority, stated before a committee of the House of Commons, "That there were no greater facilities for ascertaining the productive character of a mine now than formerly. The difference was simply in improved machinery. Our knowledge was not greater than that of our forefathers." Whatever was said in 1856, is true in 1862, and it is a sad reflection that it is so.

When the powers of the mind have been directed to any peculiar set of natural phenomena for a prolonged period, we usually discover in hypotheses advanced, and in theories more or less supported by facts, attempts to explain the causes which have been active in producing the effects observed. There is a curious absence of this in relation to mining. Beyond some very undefined notions that fire played an important part in the formation of minerals, or that mineral veins have some analogy to the veins in the animal body, or the branches of a tree, no hypotheses have been hazarded by miners proper. A few men educated in the schools of the continent, and, two or three professors of science in this country, have, it is true, promulgated their opinions, but until Werner published his theory they advanced but little beyond the creations of fancy. It will not be without interest to examine the causes of this.

The miner has ever been a distinguishable man amongst the hosts of his brother men. Working in solitude in the dark recesses of the rocks he has become thoughtful with only the dreams of ignorance on which to employ his thoughts. Hence he has peopled the subterranean world with "kobals;" and even the smothered sounds of waters dropping in some unopened cave have become to him the realisation of the "knockers"—unkind gnomes, who mock him in his toils, and who as frequently lead him from, as guide him to, the mineral mass on which they are supposed to labour. Habituated to danger, the miner becomes careless of death, and his life is a constant declaration of his belief in fatality. Superstition finds her fitting home in the dark places of the earth, and reigns supreme in the dark mind of an untaught man. Therefore the dominant Powers to the miner have been the creations born of ignorance and night. Signs and tokens, lucky and unlucky days, ill-wishes, evil-eyes, witchcraft and charms were the rulers of his life.

Although the influences of ordinary school education have penetrated to the most remote mining districts, and produced the usual humanising effects, yet the miner retains many of the peculiarities which belonged to his forefathers. Whether we examine the miners of Alston-Moor, of the dales of Yorkshire, of North Wales, or of Cardiganshire—the scattered workers of the mines of Shropshire, or the large mining population of Cornwall—we shall discover the same general peculiarities.

As a body, miners may be regarded as a religious class; but theirs is a religion of the heart, not of the head. They are powerfully swayed by their feelings, to the repression of the influences of reason. Hence the tendency to those impulsive manifestations of a religious conviction which are known as "Revivals." Except, however, where the miners have been brought under the guidance of the Wesleyan Methodists, or of the leaders of some sect who adopts the system of appealing strongly to the passions, their religion is only a superstitious dread of something unseen—unknown. Thoughtful, we have said they are, but their thoughts flow slowly and they have ever a tendency to dwell on the darker shades of life; while it is with extreme difficulty that they can be brought to communi-

cate their thoughts to others. Miners are rarely frivolous even above ground; they are specially serious below. The youngest men will express their dislike of idle conversation or of joking in the mine, whilst whistling is strictly forbidden. In the sports and pastimes of a mining village there is something peculiarly sober; and the celebration of the annual feast with its attendant fair, has something of a sombre character about it, in comparison with agricultural revels.

A sanguine temperament may be said to distinguish a miner. He is for ever hoping that stores of mineral wealth are a little in advance of his labour. Therefore, although in relation to the ordinary affairs of life he is trustworthy, showing a real love for the truth, he is curiously carried away from it when describing the state of a mine, and he expresses his hopes rather than records his knowledge. The exaggerations exhibited in some reports on mines are often of an amusing character, running, indeed, into poetical rhapsodies. Many an unfortunate adventurer has, however, to date his ruin from the day when he gave credence to the hyperbole indulged in.

From their very childhood men are trained to observe. As boys they are employed to separate the valuable ore from the useless stones with which it is mixed, and this is often a delicate operation. In their labours underground everything depends upon their careful observations, especially in those mines where the system of "tribute pitches" is adopted; the miner ("tributer," as this class is called) receiving an agreed share of the profit derived from the sale of the ores which he breaks out of the lode. Yet their powers of observation are of a very limited order. Their experience is made up of a knowledge of peculiarities existing within a confined area. So long as these repeat themselves the miner's deductions are correct; but vary the phenomena ever so slightly, and he is at once at fault. This is continually occurring. Within a circle of their labours a few men will probably arrive at a tolerably exact knowledge of the conditions existing, and this knowledge gives them a pre-eminence amongst their fellow-miners as advisers. But remove one of these men from his own locality, he is rarely able to group the new phenomena presented to his view; he feels he is ignorant, though he is rarely so boldly honest as to proclaim it; and he commits himself to statements which are only vague guesses, happy indeed, if any one of them proves correct.

(To be continued).

THE NEW METAL *THALLIUM*.

By William Crookes, F.C.S.

(Abstracted from the Proceedings of the Royal Society.)

Most of these reactions have been independently verified by my friends, E. O. Brown, Esq., and J. Spiller, Esq., of the Chemical Department, Woolwich Arsenal; and I am glad to be enabled to take this opportunity of expressing my obligations to them for their valuable aid. The reactions are sufficient to prove chemically that the body under examination is a new element. Its behaviour in the spectrum apparatus is perhaps the most conclusive test upon this point. When a minute portion of the metal (the sulphide, choride, or, in fact, any compound of thallium) is introduced into the flame of the spectroscope, it immediately produces a single green line, perfectly sharp and well defined upon a black ground, and of extraordinary purity and intensity, *almost* equal to the sodium-line in brilliancy.

It is not, however, very lasting. Owing to its great volatility, a portion introduced at once into the flame merely shows the line as a brilliant flash, remaining only a fraction of a second; but if it be introduced into the flame gradually, the line continues present for a much longer time. If, also. a piece of metallic thallium be introduced into the flame on a platinum wire loop, they fuse together, and the alloy gives the green line rather more permanently, although of course fainter.

Working on a small scale, it is not easy to obtain these compounds free from soda; but when that is effected, and a tolerable quantity of substance is held on a loop of platinum wire in a flame, the green colour is most brilliant, and produces very extraordinary effects upon the appearance of surrounding objects. If thallium could be obtained in quantity, this ready means of producing an intense and homogeneous green light could not fail to be applicable to some useful purpose.

The green line of the thallium spectrum appears to be unaccompanied by any line or band in other parts of the spectrum. A flame of sufficient temperature to bring the orange line of lithium into view produces no addition to the one thallium-line; and an application of telescopic power strong enough to separate the two sodium-lines a considerable distance apart still shows the thallium-line single. I consider therefore that I am justified in stating that thallium produces *the simplest spectrum of any known element.* Theoretical inquiries into the cause of the spectrum lines, and their relation to other constants of an element, may be facilitated now we know a metal which gives rise to luminous vibrations of only one degree of refrangibility. The remarkable simplicity of the thallium spectrum offers a strong contrast to the complicated spectra given by mercury, bismuth, and lead—the metals to which it has the most chemical resemblance.

The position of the green line does not coincide with any definite line in the solar spectrum. According to Kirchhoff's theory, we must therefore assume that thallium is not present to any great extent in the sun. Under the highest telescopic power of my apparatus, the line appears to be absolutely identical in refrangibility with a sharp well-defined line in the barium spectrum, to which Professor Bunsen and Kirchhoff have given the name Baδ. Want of material has hitherto prevented me from taking accurate measurements of the distance between the thallium-line and the principal lines of the solar spectrum.

This green is an exquisitely delicate test for the presence of thallium, and shows it to be a somewhat widely distributed element. Many specimens of crude sulphur contain it (especially when rather dark-looking). In most cases it is only necessary to set fire to as large a piece of sulphur (less than a pea) as the platinum loop will hold, and when it has nearly burned away to blow it out, and then introduce it at leisure into the flame of the spectroscope, for the thallium to shows its presence by a bright-green line which will flash for an instant into the field of view. Although the greater part of thallium is left behind after burning off the excess of sulphur in this manner, some of it volatilizes, and consequently, if the specimen gives no indications of thallium by this treatment, it will be advisable to dissolve out as much of the sulphur as possible with bisulphide of carbon, and then to test the residue in the flame.

Thallium is a constituent of very many mineral ores. Upon examining a large collection of cupriferous pyrites from different parts of the world, I found it present in more than one-eighth. It is not confined to any particular locality; neither does it seem to bear any relation to the presence or absence of arsenic in the mineral. I have, however, very rarely met with it in pyrites in which copper was absent. In most cases it is only necessary to powder a small fragment of the mineral and ignite a little of it in the

flame on a moistened platinum wire, for the green line to be distinctly visible.

If a thalliferous pyrites is finely powdered and then heated to redness in a glass tube, as much as possible out of contact with air, the sulphide of thallium, together with some free sulphur, sublimes from it and may be condensed by appropriate arrangement. The sublimate gives the thallium-line with great brilliancy.

Owing to the frequent occurrence of thallium in copper ores, it is very probable that this element may sometimes be present in commercial copper, and may give rise to some of the well-known, but unexplained, differences of its quallty. I am at present engaged in investigating this subject, and have already found some indications of thallium in commercial products.

I have no hesitation in saying that in some of our large copper, sulphur, and sulphuric-acid works, thallium is at the present time being thrown away by the hundredweight: a very slight modification of the present arrangements of the furnaces and condensing flues, or even an examination of some of the residues, would enable the whole of this to be saved. Bearing this in view, I am now in communication with several large consumers of thalliferous minerals. My applications have without exception been met with the utmost courtesy and most obliging offers of assistance, and there is therefore every probability that I shall soon have an opportunity of preparing this new element in considerable quantities, and thus be enabled to pursue the investigation with more comfort and accuracy than hitherto, when my stock of material has had to be counted by the grain.

Notes and Memoranda.

NORTHERN INSTITUTE OF MINING ENGINEERS.—The usual monthly meeting of the institution was held on Nov. 6, at the Neville Hall, Newcastle, Mr. Nicholas Wood (President), in the chair. The President stated that, in consequence of the death of the late Mr. T. J. Taylor, the committee appointed for the purpose of making experiments with a view of elucidating principles of ventilation had now become too small for efficiency. It was extremely desirable when dubious points arose in their discussions or otherwise, that they should be practically settled by direct experiments, carefully conducted.—On the motion of Mr. Atkinson, Inspector of Mines, several gentlemen were added to the committee, and the instruments purchased by the institute placed in their charge.

The President congratulated the members on the decision arrived at by the council of the British Association to hold their next annual meeting at Newcastle, and it would be incumbent on this institute to take steps to add to the success of the meeting. There was much of great interest to be seen in this neighbourhood, and he was sure that it would be of great pleasure to all present to aid in showing every attention in their power. The annual meeting of this institute, which was held in Birmingham last year, was so successful that it was determined to hold these aggregate meetings frequently, and, as the British Association would meet in Newcastle next year, it perhaps would be advisable to hold their next aggregate gathering here at the same time. The council thought it very desirable that this subject should be early taken into consideration.

The discussion on Messrs. Atkinson and Coulson's paper on "Close-topped Tubbing" was then opened.—Mr. Atkinson stated that Mr. Armstrong had pointed out to him one or two inaccuracies in the depth, &c., at Castle Eden winning, as stated in their paper. Whilst these did not affect the general results arrived at, it would be as well to have

the correct data recorded. In reference to the question of the pressure not being simply in proportion to the depth, Mr. Atkinson gave another instance in Prussia. The first feeders were tubbed off, and on sinking further other feeders were met with, and the water from these, on their being tubbed off, rose in a pipe past the first feeders, and considerably above the surface, and the discharge was used for the engine-boilers.—The President remarked that it appeared clear that one feeder in a shaft could be separated from another; if a succession of feeders were met with in a shaft, it did not necessarily follow that they were connected. He considered his view borne out in the sinking of the Seton pit, the details of which he had previously given to the institute.—Mr. Reed said the case mentioned by Mr. Atkinson resembled the usual phenomena of the Artesian well system.—The President stated, that in a case where Mr. Coulson was engaged for him in Westphalia, a very large quantity of water was met with in passing through the sand, and as there was no foundation for the cribs they were laid on the sand, and they succeeded in stopping back a large quantity of the water.—The discussion was then adjourned.

The discussion on Mr. Daglish's paper on the destructive action of furnace gases was then commenced by the President, who remarked that the upcast shafts in this district were heated now to a much higher temperature than formerly, resulting in serious decomposition of the stone, iron, and other material exposed to the action of the furnace gases at such an elevated temperature.—Mr. Johnson said the walling stones in the Haswell upcast shaft were very much decomposed and injured. They were now repairing the shaft with fire-clay lumps.—Mr. Atkinson thought that an earthenware enamel coating would form an excellent preservative to metal tubbing, if it could be applied.—The President said his son would probably be trying it at Black Boy Colliery.

The discussion of Mr. Atkinson's paper on the ventilating fan at Elsecar followed.—Mr. Atkinson stated that within the last few days he had been trying some experiments with a fan of similar construction at Torsdale Colliery, near Durham, and gave some of the results arrived at. Mr. Atkinson also gave some account and description of the fan used by the Pneumatic Despatch Company in London, by which 14 in. of water-pressure could be obtained. The principle appeared to him to be capable of being applied to the ventilation of mines with advantage. The fan consisted of two discs, and was about 20 ft. in diameter, and made about 200 revolutions per minute. It was constructed so as to allow of this velocity being obtained, whilst the Elsecar fan could not with safety be driven above 70 revolutions per minute. By the Pneumatic Company's fan he obtained 30,000 cubic feet per minute through an opening of 6 square feet.—The President said, at first the company had considered it necessary to have the piston in the tube quite tight. They now, however, found that this was not necessary, and that little loss was caused by a space being left all round the piston. This materially reduced the friction.

The meeting closed with the reading of a supplementary paper on the "Formation of Coal," by Mr. Wm. Greene, jun., which, together with the foregoing discussions *in extenso*, will be published in the Transactions of the Institute.

At the meeting of December 6th, in the absence of the President, Mr. John Marley was voted to the chair, and the minutes of the council read over. The chairman drew attention to the recommendation of the council, that the institute should subscribe 40*l.* towards the expense of fitting up, in the Museum of the Natural History Society, cases for the reception of the mineral and other specimens belonging to the institute. He asked Mr. Berkley, who was one of the sub-committee appointed to negotiate with the Natural History Society, to explain this matter to the institute. Mr. Berkley stated that the sub-committee had had an inter-

view with the Natural History Society that morning, and ascertained that their rooms were nearly ready for the reception of the specimens. It was proposed that the "Hutton Collection" should be kept together, in cases separate from other specimens, in the gallery of the smaller room. The remaining minerals, &c., would be labelled with the initials of the institute, so as to retain their proprietorship. These would be mixed in their proper order with the other specimens belonging to the Natural History Society, so that both collections would be rendered available, in the best manner, to persons wishing to study them—and, in fact, to the public generally. Mr. Potter asked if the casing would be the property of the institute?—Mr. Berkley: No; it would belong to the Natural History Society—Mr. John Ramsay understood that the institute became members of the Natural History Society; in addition to the donation of 40*l.*, they would be subscribers of 20*l.* annually to aid in the maintenance of a curator, &c.—Mr. Berkley: The institute would be representated in the council of the Natural History Society. The confirmation of the recommendation of the council was moved and carried. The meeting then proceeded to fill the office of vice-president, vacant by the death of the late Mr. W. Anderson; and on the votes being taken, Mr. Hugh Taylor, of Earsdon, Chairman of the Coal Trade, was elected. In the absence of Mr. Coulson and Mr. Greene, the discussions on the papers announced were again adjourned.

Geological Society of London.—At the meeting of this Society on Wednesday, December 3, Professor A. C. Ramsay, President, in the Chair:—.

Edward Hesketh Birkenhead, Esq., Master of the Wigan School of Mines: Antonio Brady, Esq., Maryland Point, Stratford, Essex; Samuel Higgs, Jun., Esq., Assistant-Secretary of the Royal Geological Society of Cornwall, Penzance; and Alan Lambert, Esq., 2, Portugal-street, Grosvenor-square, London, were elected as Fellows.

The following communications were read:—

1. "Description of the Remains of a new Enaliosaurian (*Eosaurus Acadianus*), from the Coal-formation of Nova Scotia." By O. C. Marsh, Esq., M.A. Communicated by Sir C. Lyell, V.P.G.S.

2. "Description of *Anthracosaurus*, a new genus of Carboniferous Labyrinthodonts." By Professor T. H. Huxley, F.R.S., F.G.S.

3. "On the Thickness of the Pampean Formation near Buenos Ayres." By Charles Darwin, Esq., M.A., F.R.S., F.G.S.

4. "Geological Notes on the locality in Siberia where Fossil Fishes and *Estheriæ* were found by Dr. Middendorf." By C. E. Austin, Esq., C.E., F.G.S.

These fossils were obtained from a bed of shale in a low cliff about 200 versts south of Nertschinsk, forming the west bank of Tourga, a small tributary of the River Onon. The author gave a detailed section of the cliff, and noticed the volcanic and sedimentary rocks of the district, and more especially referred to the far-famed, gem-containing granite of Oden-Tchalon.

5. "Note on *Estheria Middendorfii*." By Professor T. Rupert Jones, F.G.S.

Two ancient stone axes from Trinidad, and one from Santa Cruz, were exhibited by J. Lamont, Esq., F.G.S.

The Patent Laws and Coke Ovens.—The following excellent letter has been addressed to the Colliery Guardian, by Mr. A. L. Steavenson, of Guisbro', Yorkshire:—

Amongst your weekly list of inventions connected with the coal and iron trade, there occurs regularly, and sometimes two or three in one week, notices of Patents taken out for improvements in coke ovens and in the manufacture of coke. As it is a subject to which I have paid some attention, I generally read these notices, and having been struck with

the similarity which exists throughout the whole of these, I beg to call attention to the fruitless waste of time and money which occurs from the want of inquiry on the part of the persons taking out such Patents.

For instance, on the 31st May, 1853, Mr. Joseph Dunning takes out a Patent which he states to be for the purpose of facilitating the process of coking. "Instead of allowing the heat arising from the ignited coal in the oven to pass away at the top or back of the oven, it is made to circulate under the floor and along a part of the sides of the oven by means of certain flues," which it is unnecessary minutely to describe. The inventor further states that he does not claim to himself any particular shape, or size, number of flues, or any particular position in the oven, but simply the construction of vertical and horizontal flues in the sides and under the floors of coke ovens, for the purpose of applying the heat of such ovens more directly to the lower portion and the under surface thereof, than has hitherto been practised.

I may state that the licence for this patent was not renewed, and the patent then *lapsed to the public.*

In June, 1860, a patent was taken out for an invention which was stated to consist in constructing ovens with one, two, or more flues, for the purpose of conveying the gases when in a state of combustion underneath the floor of the ovens, and afterwards into the chimney. The patentees state that they do not limit themselves as to the shape of the oven, and the number of the flues may be considerably varied, but claim an improved arrangement of flues for heating the floors by means of the ignited gases escaping from the coal during the process.

And now, in September, 1862, we find Mr. John Steven Joseph taking out a Patent for Improvements in Coke Ovens, and in utilising the heat for the same. The old story of side and bottom flues is repeated, with the addition of small orifices in the brickwork, to admit atmospheric air, to cause the perfect ignition of the gases. This latter improvement is as old as any of the patents I have already named, and I have myself used it several years ago. But not content with this, Mr. Jones has patented the common process for producing gas, which is described as "An Improved Retort Oven," and the utilisation of the spare heat from the same, which by preference is to be applied to heat steam boilers, heat drying stoves, &c., &c., all of which valuable inventions did not wait for their development at this late period. But looking down the same column of your edition for September 27, 1862, page 253, we find a gentleman in the Royal College of Chemistry, Government School of Mines, has been patenting the process of Coke making in a close vessel or Retort, which Retorts are to be heated by means of the combustible gas evolved from the coal during the coking process. What does Mr. Joseph say to this? Two patents in the same week in which I as a disinterested observer cannot see the slightest difference. The moral which I wish to append is simply—It is well to observe and note where any improvement can be made, but by all means before taking out a patent for an improvement in the manufacture of coke, take some little trouble in ascertaining whether it is not already done. I do believe that at present there are a score of patents on this subject, which to all intents and purposes are identical. If I have only noticed two or three it is not because I could not have given more instances but that it is unnecessary.

Then there are patents innumerable for removing sulphur from the coke, taking the ammonia from the smoke, or evolved gases, which is well ascertained to be in such small proportion as to be almost valueless when the cost of extraction is taken into account. Next, we have *bad coals* mixed with tar, pitch, lime, &c., &c., producing *first-class coke.* And then, there are the hot air patents, which are intended to work most extraordinary revolutions, with the addition of electricity applied to the coke at correct intervals, to neutralise everything of an injurious character; and lastly,

there are the old-fashioned round ovens, with or without common flues and chimneys which stand unrivalled at the present day for general and universal use, which is the best test of practical value.

THE RATING OF COAL MINES.—Numerous difficulties have from time to time arisen in the important coal-field of Northumberland and Durham from the absence of any definite principle by which coal mines should be assessed to local rates. Mr. Hedley has made a communication to Mr. William Stobart on the subject. Mr. Hedley commences by saying that hitherto overseers in assessing coal mines have in some cases founded their estimate on the quantity of coal produced, and in others by a mere "rule of thumb." This Mr. Hedley considers unfair, and considers the fair principle should be based upon an estimate of the net profits.

Referring to the assessments of docks, railways, gas, waterworks, &c., he holds that the principles applied in these cases should be applied to collieries. He then enters in detail into the methods by which this valuation should be arrived at, and concludes with the following sketch of a valuation according to his scheme :—

				£	s.	d.
Estimated gross value of the coal produced by the mine at the pit mouth....				12,000	0	0
Deduct,—						
Working expenses, say sixty per cent., including materials and other charges generally included under this head	7,200	0	0			
Viewers' salaries and proportion of general offices' expenses	1,000	0	0			
Allowance to a tenant for management, &c.	500	0	0			
				8,700	0	0
Net profit				3,300	0	0
Tenant's Capital and Plant,—						
Cash for wages, materials, and other outgoings for six months, say	4,350	0	0			
Value of horses, tubs, tools, and implements, say....	600	0	0			
Total value	£4,950	0	0			
On which allow five per cent. interest	247	0	0			
25 per cent., tenant's profit	1,235	0	0			
Renewals of tenant's plant, twenty-five per cent. on £600	138	0	0			
				1,620	8	0
Gross rent				1,680	0	0
Deduct ⅛th for repairs &c....				286	10	0
Rateable value				1,393	10	0

IMPROVED GONIOMETER FOR MINE DIALLING.—A goniometer for mine dialling has been invented by Dr. August Junge, professor of the higher mathematics, and teacher of practical mine surveying in the Royal Mining School of Freiberg, Saxony. It consists of an improved theodolite, and a couple of optical signal boxes, with a light inside at which to take the sights. Both the theodolite and the signal boxes are so mounted as to be capable of assuming various angles to each other, and are connected with each other by a cord which passes round the supporting stem of each. The distances between the instruments and the rise or fall are taken in the

usual manner. The accuracy of the survey made by the goniometer (angle measurer), of course, depends upon the care with which the angles are taken. When the goniometer is to be used for surveying at surface all that is necessary is to mount it on a tripod, when it can be used in the same manner as a small theodolite. The goniometer, however, although of the nature of a theodolite, has certain differences which are worthy of notice; it has no altimeter-circle, and above the telescope open sights are provided. Professor Junge regards as new and peculiar in his dialling goniometer the protecting clamps over the regulating screws, for levelling the instrument; the spindles round which the cord passes, and upon which the goniometer and optic signals are mounted; the construction of the optic signals, which are semi-cylindrical lamps, with ground glass in a circular opening in front—the ground glass has division lines across, and in a concentric circle; the iron bearer on which to support the goniometer and signals; and the gimlet, or auger, with which to bore the holes to fix the instruments in. The spindles which support the instruments have male screws at the top, and the instruments fit on by a socket beneath them, carrying a female screw. Professor Junge has had much practical experience with the instrument, and is convinced of its utility and superiority. He finds that whatever may be done, in the way of surveying with the compass may be done with the dialling goniometer; that the goniometer may be used in all places where there is sufficient room to survey with the compass, whilst the goniometer has the additional advantage that it may be used in shafts of any inclination as well as in levels; that in general the survey is made quite as quickly with the goniometer as with the compass; where long straight sights can be taken the goniometer saves time, but where the sights are short, and the curves numerous, the survey is most quickly made with the compass; but even in the latter case as much can be done with the goniometer in three hours as with the compass in two; the survey with the goniometer is remarkably exact, and the instrument is as easily and conveniently handled. Compared with the theodolite, the survey is more speedily made with the goniometer under all circumstances, and especially in shafts, where, indeed, the theodolite can only be used with much difficulty and inconvenience. But this is not all, for the cost of the complete apparatus for surveying with the theodolite is from twice to three times dearer than for that necessary for surveying with the dialling goniometer. The instrument has been patented in Saxony, and a large number of them have, it is said, been manufactured and sold by Osterland, the mathematical instrument maker of Freiberg, who has purchased Professor Junge's patent right.

Mining, Quarrying, and Metallurgical Review.

WESTERN COUNTIES.

In Cornish and Devon Mines there has been no particular feature during the past month. No new discoveries of any moment have been made, and things are generally dull. West Cornwall is every day becoming more and more dependent on the price of tin, so that the present dulness of this metal communicates a corresponding dulness to the mining interest.

The most exciting theme is the Caradon district. Those interested in it—both as agents and share jobbers—stoutly maintain that its mines are worth double of any in the Western districts making similar profits. For our part we deny this *in toto*, and we rather incline to believe that on the other hand they are scarcely worth one-half. When agents mix themselves

up in share-jobbing we know pretty well, from the experience of other places, what the result will be; and it is easy to see the wreck of many reputations in this district within the next ten years. Ludcotts at 25*l.* and East Caradon at 55*l.*, will leave a mark on the district that will affect it for half a century.

One of the happiest mining successes for the last four years has been made in the case of South Exmouth Lead Mine, in the valley of the Teign, near the village of Hennock. The lead district of Christow and Hennock, in which this mine is situated, is made up of a zone of north and south lodes which skirt the eastern side of Dartmoor, between the granite hills and the River Teign. In this zone several mines have been worked with varying fortune, but on the whole with a fair amount of success: among these the best known are Wheal Exmouth (now abandoned) and Wheal Frank Mills. The South Exmouth mine, which is the most southern of any serious working on the run, was commenced at surface nineteen months ago, under the pursership of Mr. Charles Wescombe, of Exeter, and the management of Captain Joseph P. Nicholls of Wheal Frank Mills. Within that short period two first-rate engines have been erected, under the direction of Mr. Matthew Loam of Liskeard; 485 tons of lead ore, realising 6,130*l.*, have been returned; and during the last three months a profit of 1,456*l.* has been realised, out of which at the last meeting (on Dec. 11) a first dividend of 1,250*l.*, or 5*s.* per $\frac{1}{1000}$th share was declared. This piece of ground has long been favourably known to those conversant with the district; but the disfavour with which Devonshire mines are generally regarded had prevented its working. The present starting is due to the enterprise of Mr. Wescomb who—besides the shares subscribed by his immediate friends—took up himself a preponderating interest in the concern: one of those bold ventures which, in the eyes of the world, are only justified by a successful result. The rapid and prosperous development of the mine is due to Captain Nicholls, who is well known as a thoroughly able and energetic miner. To mark their sense of his ability and energy, the shareholders, at the meeting of the 11th, presented him a testimonial in plate worth 30 guineas. Judging from the reports of Captain Nicholls and Mr. Adam Murray, F.G.S., the present prospects of the mine are better than ever, and are such as to justify the hope that the prosperity of the South Exmouth will be as permanent as it has been rapid.

The discovery of serious defalcations in the case of a purser in one of the western tin mines, together with some other matters, has drawn a good deal of attention to the subject of mining account-keeping. The defaulter in question was not a Cornishman, but a person sent down from one of the northern counties to represent the interests of outside shareholders; and instances of irregularities, amounting to fraud, are of unusually rare occurrence in Cornish mines. Still it must be admitted that in many concerns the system of account-keeping is radically defective, and such as calls for a thorough revision. In too many instances the accounts presented to the shareholders do not in the least represent the true position of the concern; and in fact in many large mines there are no books kept, in the proper mercantile meaning of the phrase. A regular system of mine book-keeping, checked by a proper audit, should be insisted on by shareholders in every Cornish mine.

Our readers may remember that we have once or twice referred to the Old Wheal Neptune mine, near Marazion, which has been recently put to work by a limited liability Company. To work this mine a capital of at least 30,000*l.* would be required. Instead of obtaining such a capital as this, the concern was started with a nominal (limited) capital of 15,000*l.* out of which 7,750*l.* in money and shares was paid to the promoters as premium—leaving 7,250*l.* to work the mine, if even all the capital had

been subscribed for. But even this was not the case, and the subscribed capital available for working is now nearly exhausted, although the engine is not yet in the house; so that if the project is to go on fresh capital must be subscribed, a very difficult operation under the limited liability system. In one of his pamphlets Captain Charles Thomas says—and it is one of the best things he ever said—"Money lavishly squandered in premiums is a loss to the mining interest, and should be kept in check by every lover of his country and his class." In this view, the case of Wheal Neptune, where more than half the *nominal* capital, and a considerably greater proportion of the *subscribed* capital was absorbed in premiums, should be held up to the strongest reprobation.

At a special meeting of the adventurers of Tincroft mine, on December 1st, a resolution was passed placing the concern under the Cost Book system. Hitherto this has been a "scrip" Company, the shares passing to bearer. Companies of this class cannot now be constituted, and there is only one remaining in Cornwall and Devon—the Tamar Silver Lead. It is a very unsatisfactory constitution, and has acted detrimentally to Tincroft.

Two rather bad casualties have occurred in Cornwall. At Botallack stamps, in St. Just, the engine house has been burnt down; and at Carn Brea, on the 16th, the boiler of the stamp's engine burst, killing one man and injuring several others.

A Company called the Great Devon and Bedford Copper Mining Company has been advertised. Its proposal to purchase the Colchartan farm, near the Devon Consols Sett has been frequently before the public. If, when this district was in full swing the project always failed, it is scarcely probable it will succeed now.

WALES AND THE BORDERS.

South Wales.—The iron trade during the past month has not been characterised by the same amount of activity as was the case a month or so ago. The orders for rails have been coming in slowly, causing a decline of fully 2*s*. 6*d*. per ton on last prices. Still there has been a brisk continental demand for all descriptions of Welsh iron, and it is hoped that after the new year sets in things may improve.

The demand for coal has been about the same, but the weather having been unfavourable for shipping the collieries have been going on rather slowly. Prices however remain firm and the coal-masters are looking forward to a future rise.

Great efforts are being made to improve and increase the dock accommodation at Llanelly, and with the numerous railways which are intended to be connected with it, it is to be hoped that Llanelly will soon hold a high place among the Welsh ports.

The trade of Swansea during November was characterised by great activity, and the port was visited by a much larger class of shipping than is usually the case. The returns show that 430 vessels entered the port, with an aggregate registered tonnage of 51,562 tons, and the total shipping rates received were 1,302*l*. 1*s*. 8½*d*. For the corresponding month of 1861 the number of ships entering the port was 436, with an aggregate registered tonnage of 52,203 tons; whilst the total shipping rates received were 1,299*l*. 14*s*. 7*d*.—the difference in the receipts being in consequence of the class of vessels entering the port being of larger tonnage than in the month of November, 1861. With respect to the exports, the number of vessels leaving the port was 437, with an aggregate registered tonnage of 52,113 tons, or a burthen tonnage of upwards of 70,000 tons; the larger portion of the ships leaving the port take back-freights of either coal or patent fuel. At Neath a large coasting trade was done, and both the exports and imports were fully equal to the average.

Cardiff maintains the lead of the Welsh ports in the export both of coal and iron. During November 314 vessels cleared for foreign ports, taking out 104,022 tons of coal; 9,443 tons of iron; 1,299 tons of coke; 1,325 tons of patent fuel, and some articles of no importance. The total quantity exported in the 11 months ended November was 1,212,738 tons of coal and 165,440 tons of iron, against 1,031,217 tons of coal and 124,172 tons of iron during the same period last year, showing an increase of 181,521 tons of coal, and 41,268 tons of iron.

On December the 16th the Risca collieries were offered for sale without reserve and were purchased by Captain Rhodes, one of the directors of the old company, for 38,000*l.*

The Pontnewydd Tinworks were offered for sale by Messrs. C. Evans and Son, at the Westgate Hotel, Newport, on December 18th. The highest bidding only reached 7,000*l.*, and the property was bought in. The reserve price was 10,000*l.*

The Llanharry Hematite Iron Ore Mines have been bought in by Mr. John Bethell at a very low price.

It is feared that one of the Pontypool furnaces will shortly be blown out, the reason given being the insufficiency of coal on the spot, and the present price of iron will not pay to bring it from Ebbwvale.

MERIONETHSHIRE.—Two more gold companies have made their appearance since our last number. The *Welsh Gold Mining Company*, in 60,000 shares of 1*l.* each, whose object is to work the Berthllwyd (Cefn Coch) and Goetref mines, held upon tack-notes from the Crown, for grant of lease for 21 years, at a royalty of 1-12th. The purchase money has been fixed at 35,000*l.*, all in fully paid-up shares; and the *East Cambrian Gold Mining Company*, with a capital of 50,000 in shares of 1*l.* each.

GLOUCESTERSHIRE.—Among the imports into Bristol during the month have been: 370 tons of pig-iron; 300 tons of old iron; 366 tons of sulphur ore from Pomaron; 800 pigs, lead, from Malaga, and 100 tons of coprolite from Ipswich. Among the the exports: 1,306 tons of coal, and 705 boxes of tin and terne plates.

A prospectus of the *Bristol and South Wales Zinc Smelting Company* has been issued with a capital of 100,000*l.* of 10,000 shares of 10*l.* each. Of these 2,500 are "free" or fully paid up, and the remaining 7,500 have a preferential dividend of 7½ per cent. The property is described as consisting of 14 acres of freehold land, a proved coal field of 138 acres, and three zinc mines—two in Cardiganshire and one in Carmarthenshire. For this it would appear that 39,500*l.* is to be paid in cash and 25,000*l.* in paid up shares—making 64,500*l.* in all. It is stated in the prospectus that zinc smelting in this country has yielded enormous profits, which however we fear is very far from being the case. This concern was brought out about a year ago under another name, when it fell through.

MIDLAND COUNTIES.

STAFFORDSHIRE AND WARWICKSHIRE.—The iron trade in this district has been steady, but during the latter part of the month orders have fallen off, as was to be expected at this time of the year. The continental trade has been very fair, principally to France and Germany. The colonial trade also keeps up and the demand for India is increasing. There is a disposition to purchase pig-iron for next quarter, but manufacturers of finished iron are not inclined to give any advance on the rates paid at the beginning of the quarter. The demand still keeps up for plates both ship and boiler.

The partial strike of the colliers in the Dudley division of the East Worcestershire district is now at an end and the local demand for thick

coal is improved, but the demand is not widely felt. At the same time the winter season is giving rise to a growing inquiry for fuel for domestic use throughout the whole of Staffordshire, north and south. Prices are as a rule low, the great competition having prevented sellers obtaining the rise for which they hoped.

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—The iron trade in this district has been very brisk, and in Cleveland especially, the furnaces are nearly all in blast and the miners in full work. It is stated that two firms propose to erect new furnaces in the neighbourhood of Hartlepool. In South Durham and Cleveland a greater number of works are in operation than was ever recorded before, and but for the anomalous position of the Consett Works, which out of a total of 18 furnaces returns 13 as out of blast, the proportion of "outs" to "ins" would be very small indeed as will be seen by the following figures: taken on the 1st of December.

Place and Owners.	In.	Out.	Total.
Eaton—Bolckow and Vaughan	9	—	9
„ Clay Lane Company	3	—	3
„ Samuelson and Company	3	—	3
Cargo Fleet—Jones, Dunning, and Co.	2	—	2
„ Cochrane and Company	4	—	4
„ Gilkes, Wilson, Pease, and Co. ..	4	1	5
Middlesbrough—Bolckow and Vaughan	2	1	3
„ Hopkins and Co.	2	—	2
Port Clarence—Bell Brothers	5	1	6
Norton—Warner, Lucas, and Barrett	3	—	3
Stockton—Holdsworth and Co.	2	1	3
Thornaby—W. Whitwell and Co.	2	1	3
Darlington—South Durham Company	2	1	3
Ferry Hill—J. Morrison	3	—	3
Witton Park—Bolckow and Vaughan	4	—	4
Stanhope—Weardale Iron Company	—	1	1
Towlaw—Weardale Iron Company..	4	1	5
Consett—Derwent Iron Company	5	13	18
Total	59	21	80

The chemical market is rather slow and prices have undergone no alteration. Shipbuilding is carried on in the Tyne and Wear with great activity and most of the yards promise to be busy for some time to come. The coal trade, on the whole perhaps, has a more healthy appearance, but the production is still limited, and several pits are working short time. We think it scarcely likely that there will be any change of consequence until the turn of the year. In the iron trade all is bustle and activity. We believe there is not a single blast furnace "out" between the Tyne and the Wear.

Among the exports for the Tyne during the month have been: 99,792 tons of coal; 65,830 cwt. of iron; 8,295 tons of coke. Among the imports: cargoes of pyrites from Pomaron, Antwerp and Garrucha: pig-iron and pig lead from Gothenburg, and 147 tons of iron from Pomaron.

The South Medomsley colliery, which has been laid in for about a hundred years, has been re-opened by Messrs. Bainbridge, Muschamp and Kirsop, of Newcastle.

YORKSHIRE.—A dreadful colliery explosion occurred near Barnsley on December 8th, at Edmond's Main colliery one of the most extensive collieries in the Barnsley seam.

The primary cause of the accident was the ignition of a "blower" of gas by the blasting of the coal at the extreme "dip point" at the southernmost extremity of the workings. Three different explosions took place; the first at seven o'clock in the morning, the next at half-past eleven, and the last at about one o'clock, after which the state of the mine was such that all who were in it at the time must have been either burnt or choked by the after-damp. Fifty-four lives were lost and sixteen people more or less injured.

The explosions at this colliery have since been repeated. On the 24th there was a consultation of engineers upon the propriety of allowing a party to descend the shaft, who, fully expecting a decision in the affirmative, were ready to descend, when it was agreed to postpone the attempt. Hardly was the decision made known to the disappointed pitmen, when the neighbourhood was startled by the boom of an explosion far louder, sharper, and more terrific than even that which sealed the fate of the men still in the pit on the afternoon of the 8th instant.

At the inquest on the explosion at Edmund's Main Colliery, on the 23rd inst., the jury returned a verdict that the deceased came to their deaths by an explosion of gas, but the jury were unable to attach blame to any individual. At the same time it was their unanimous opinion that the cause of the explosion was owing to the incautious working of the dip board of the colliery. The mode of blasting with powder they consider to have been highly injudicious. Mr. E. Parker protested against the verdict.

SCOTLAND.

Coals have been in good demand for home use and for export at very full prices. The quantity shipped at the principal Scotch ports foreign and coastwise during the month was 93,356 tons, against 77,130 tons in the corresponding period last year. Showing an *increase* of 16,226 tons.

The pig-iron market has been very flat and prices much depressed. The number of furnaces in blast in at the end of November was 125, an increase of seven as compared with October.

The men at Thankerton and Legbranock collieries have struck for an advance of wages, the demand has been resisted and they have removed their tools and sought work elsewhere. The Armadale miners who struck a short time ago have resumed work on the advance demanded.

THE CONTINENT.

In the Haute Marne district considerable activity prevails, although not so much as might be anticipated at this season of the year; which is generally lively in this district. The use of coke in the making of pig-iron has become very general, and pig made with charcoal only is very scarce and costs 5*l.* 8*s.* per ton. Iron is comparatively neglected, the latest quotations from St. Dizier are, rolled pig 9*l.* 8*s.* to 9*l.* 12*s.*; hammered 10*l.* 16*s.* to 11*l.* 4*s.* per ton.

BELGIUM.—The advices with respect to the coal trade are more cheering than they have been for some time. There is a decided revival of activity especially in the working of rich coal. The Belgian iron market is much the same. At the beginning of the new year a rolling works for merchants' iron, which has been constructed at Marchienne, will be put into operation. It seems that in Belgium the make of iron is receiving more attention than the production of pig.

PATENTS RELATING TO MINING AND METALLURGY.

COAL CUTTING BY MACHINERY.—This invention patented by Messrs. Ridley and Rokeby, consists in combining compressed air engines with picks and tools, which are mounted on carriages moved on and guided by tramways, and are arranged to cut longitudinal, horizontal, and also upright grooves to the desired depth or on the upright face of the work, and thus to divide it into rectangular sections, each section being bounded by grooves on three or four sides. For these purposes a carriage mounted on wheels is employed, on which is placed a compressed air engine, which is constantly in connection with a suitable pipe with machinery at the top of the shaft, so arranged as to keep up a constant supply of pressed air to the compressed air engine on the carriage described, and a flexible length of pipe is used between the compressed air engine and the fixed air pipe, in order to allow of the carriage moving a distance along the work. On the carriage is applied any number of picks or lever handles, moving on axes, the the lever handles being, by preference, cranked levers, so that at one end the pick is applied, and at the other end the lever is acted on directly, or is attached by a connecting rod to the piston rod of the compressed air engine, hence, as the carriage is moved at intervals along the face of the work, horizontal and longitudinal grooves are made in the upright face of the work by repeated blows of picks moving on an upright axes, and in order to make the necessary upright groove, the picks are applied to the carriage, and they receive motion in a similar manner from the compressed air engine. The air to work the apparatus is compressed at the mouth of the pit by an air pump, worked by an engine, and the air is led into the pits by means of iron pipes. The coal cutter has been at work several months at West Ardsley Colliery, and its performances are said to be satisfactory.

ARRESTING SKIPS.—Mr. G. B. Goodman (No. 1,240) has patented an apparatus for arresting the descent of mine skips or cages. On the four sides of the shaft conducting slides or guides are fixed racks, teeth, or steps extending from the top to the bottom of the shafts. The skip or cage is furnished with four bars or bolts which are placed immediately opposite the slides or guides in the shaft. The bars or bolts are furnished with projections which protrude over the top edge of the skip or cage and fit into the cavities of the guides or slides of the shaft and lodging on the rack or teeth prevent the skip from descending the shaft.

MALLEABLE IRON.—Mr. E. B. Wilson (No. 1,260) has obtained a patent for an improvement in the machinery or apparatus used in the manufacture of malleable iron and steel. It consists of a vessel of wrought iron, lining it with fire brick, ganister loam, or any other suitable refractory substance, suspending it on its axes. The vessel is closed at one end fitting in the twyer or air pipe, leaving the other end open.

SAFETY LAMP.—Mr. James Maiden (No. 1,271) has patented an improvement in the safety lamp by which he makes the ordinary Davy lamp, self locking and self-extinguishing, by causing a thimble at the bottom part of the lamp to turn on an eccentric, so that when the gauze top or cover is placed on the bottom part, by turning it round one way, it will come in contact with a catch, and be locked, and and by merely opening the lamp, the light is extinguished.

MANUFACTURE OF IRON.—Mr. John Gay Newton Alleyne, of the Butterley Iron Works (No. 1,198) has patented an invention of improvements in machinery and apparatus for the preparation and manufacture of iron and steel. It has for its object the more expeditious working of wrought iron or steel in the processes of hammering, rolling, and trimming or gauging after rolling by cutting. One part of this improvement relates to the hammering of masses of iron or steel into shape, preparatory to rolling, and consists in arranging two or more steam hammers to act upon one and the same mass of metal in two or more different directions at the same time. There are also some other modifications of the invention.

CONSUMPTION OF SMOKE.—Messrs. Pickard and Morris (No. 1,154) have provisionally specified a means of causing the consumption of smoke in furnaces by admitting common air to the front part of the bridge of the furnace in quantities proportioned to the amount and quality of fuel consumed. The air is supplied through the ash pit or otherwise to the bridge of the furnace by means of tubes, doors, or other passages, and passing out of the front part of the bridge by an opening, mingles with the gases and smoke or other products of combustion before they pass over the bridge, causing their perfect ignition or consumption, and effectually preventing the escape of any unconsumed combustible matter through the flues or chimney.

SUPPLYING CONDENSERS WITH WATER.—Letters patent have been granted to Mr. James Chapman Amos (No. 1,164), for the invention of an improved mode of, and improvements in, apparatus for supplying surface condensers with water, part of which improvements is applicable to blowers and rotary pumps generally. The object of this invention is first to provide a ready access to the fan or impeller of rotary pumps, particularly when applied to the injection of water into surface condensers, and also when required to the fans of blowers. The above remarks apply also to blowers; secondly, when applying rotary pumps for injecting water into the surface condensers of marine engines to draw the water at pleasure, either from the exterior or interior of the ship. It is proposed to carry out this part of the invention also in connection with reciprocating pumps.

LINING FURNACES.—Mr. Robert Mushet (No. 1,202) has patented an improvement or improvements in the lining, repairing, or "fettling" of the puddling furnaces, and consists in employing that ore of titanium called ilmenite, in place of "bull-dog." or other materials, for the purpose of lining, repairing, or "fettling" the sides of the puddling furnace. In carrying the invention into operation, the sides of the puddling furnace are lined with lumps of ilmenite, from two cwts. to five cwts. of ilmenite lumps being introduced for the purpose, according to the size of the puddling furnace. When the lining or "fettling" of ilmenite has become worn away by the action of the iron slag or cinder during the operation of puddling, the lining of ilmenite is renewed from time to time as such repairs may be required.

PRECIPITATING COPPER AND SILVER FROM THEIR SOLUTIONS.—An invention applicable to the treatment of solutions containing salts of copper and silver, obtained by well known processes, has just been patented by Mr. G. Bischof, of Swansea. He throws down the copper by finely divided iron obtained by reducing an oxide, sulphide, or salt of iron, taking care to avoid fusion. To obtain this finely divided iron, Mr. Bischof grinds burnt ores from the manufacture of sulphuric acid, and mixes them with 25 per cent. of coal; the mixture is kept at a red heat in retorts for 8 to 12 hours, and cooled before exposure to air. With this finely divided iron it is stated that a very pure precipitate is obtained. When the solution contains persulphate of iron, such persulphate is decomposed with magnetic oxide or carbonate of iron, the basic sulphate is allowed to settle, and the solution is drawn off, and the copper precipitated. Metallic silver may be obtained by precipitating the silver as chloride, and then converting this into sulphide by treating with sulphide of sodium or potassium.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Oct. 23. 2859. H. Donald Johnstone, Renfrew, N.B., improvements in machinery or apparatus for bending or straightening metal plates.

„ 28. 2903. E. S. Tudor, Upper Thames-street, improvements in the purification of lead.

„ 28. 2905. J. Jeffreys, The Rise, Hoddesdon, Herts, improvements in constructing surface condensers, and apparatus for treating and cooling fluids.

„ 28. 2904. C. S. Duncan, Inverness-road, Bayswater, an improved compound or material for coating or covering metallic and vegetable substances to preserve them from corrosion or decay.

Oct. 29.	2909.	G. Darlington, Minera, Denbigh, improvements in the manufacture of zinc oxide.
„ 29.	2913.	W. Clark, 53, Chancery-lane, improvements in the treatment of copper ores, and in apparatus for the same. (A com.)
„ 30.	2926.	H. Eastwood, Elland, Yorkshire, improvements in boilers and furnaces.
„ 31.	2938.	H. L. Corbett, Inchiore Dublin, improvements in the construction of twyers.
Nov. 8.	3021.	E. Sonstadt, 3, Stewart-place, Alfred-street South, Nottingham, improvements in the manufacture of magnesium.
„ 12.	3043.	W. and J. Galloway, Manchester, improvements in machinery or apparatus for cutting, shaping, punching, and compressing metals.
„ 18.	3094.	P. H. Klein, Paris, machinery for turning or shaping metals or other substances.
„ 19.	3106.	R. Mushet, Coleford, Gloucestershire, an improvement or improvements in the manufacture of cast steel.
„ 19.	3108.	J. Arbos, Barcelona, improvement in generating certain gases for obtaining motive power, and in the apparatus employed therein.
„ 25.	3157.	J. Moule, 15, Seabright-place, Hackney-road, an improved method of deodorizing mineral oils and hydro-carbons.
„ 25.	3159.	A. L. Woolf, Birmingham, a new or improved metallic alloy.
„ 26.	3175.	A. V. Newton, 66, Chancery-lane, an improved mode of preparing oxide of zinc as a pigment. (A com.)
„ 27.	3178.	F. W. Hartley, 55, Millbank-street, Westminster, improved means of obtaining certain products resulting from the manufacture and purification of coal gas.

Coal Markets.

LONDON.—From the Return of the Registrar of the London Coal Exchange, of the quantity of sea-borne Coal, Culm, and Cinders, imported into London in the month of November, we learn that the total quantity was 323,889 tons, against 322,431 tons during the corresponding month of last year, showing an *increase* of 1,458 tons. The total quantity imported during the eleven months ended November 30th, was 3,201,963 tons against 3,094,348 tons during the corresponding period last year—showing an *increase* of 107,615 tons.

The following are the particulars of the 323,889 tons imported during November:—

Newcastle ..	122,291	tons, in	344 ships	Scotland ..	1,944	tons, in	10 ships
Seaham ..	16,811	„	69 „	Wales ..	6,337	„	15 „
Sunderland .	105,547	„	275 „	Yorkshire ..	3,690	„	33 „
Middlesbro'.	4,749	„	21 „	Small ..	446	„	3 „
Hartlepool..	57,419	„	195 „	Cinders ..	1,350	„	6 „
Blyth ..	3,305	„	13 „				

The quantity of coal imported by railways and canals during the month of November, was 152,621 tons against 164,160 tons during the corresponding month last year—showing an *increase* of 11,539 tons.

At the close of November large arrivals gave an abundant supply of house and steam coal and caused a dull market. The prices for the different kinds were best house coal 18*s.* 6*d.* to 19*s.*; seconds 17*s.* to 18*s.*; Hartley's 14*s.* 6*d.* to 15*s.* 6*d.*; manufacturers' 13*s.* 6*d.* to 15*s.* per ton. On

December 1, the market for household coal was very dull and little business was done. Hartley's were much depressed, and sold at a reduction of 3*d.* per ton. Manufacturers' in short supply and rather dearer. On the 3rd the mild weather increased the heaviness of the market for house coal, and caused a reduction of 6*d.* per ton; Hartley's a shade dearer. On the 5th the tone of the market for house coal was again dull, and prices remained at last quotations; Hartley's improved 6*d.* per ton; manufacturers' steady at previous value. On the 8th the quantity on sale was very trifling, and the market dull throughout, at last quotations. On the 10th there was little disposition for business, and prices of house and manufacturers' remain at last rates; Hartley's gave way 6*d.* per ton. On the 12th large arrivals took place, which afforded an abundant supply of all descriptions of coal: household sorts fully maintained previous value, but Hartley's and manufacturers' both receded 6*d.* per ton. On the 15th more large arrivals caused a dull market: house coals maintained the price of last quotations; Hartley's were still further reduced 6*d.* per ton. Manufacturers' also a shade lower. On the 17th the tone of the market was heavy for all descriptions of coal, at last prices. On the 19th the business in house coal continued dull, at last quotations; Hartley's a shade lower; manufacturers' without alteration.

General Exports of Coal.—From Messrs. J. and T. Platt's Coal Circular for December, we find that the quantity of *coal, cannel, coke, and patent fuel shipped from Liverpool* to foreign and colonial ports during the month of November was 57,230 against 47,462 tons, during the corresponding month of last year—showing an *increase* 9,768 tons. The total quantity shipped during the eleven months ending November, was 580,452 tons, against 600,465 tons during the same period last year,—showing a *decrease* of 20,013 tons. The shipments coastwise during the month of November were 8,499 tons, against 9,754 tons during the corresponding month of last year,—showing a *decrease* of 1,255 tons. The total quantity shipped coastwise during the eleven months ending November was 77,705 tons, against 83,256 tons during the same period last year,—showing a *decrease* of 5,551 tons.

The oversea exports of coal at Bristol during the month of November amounted to 1,544 tons, against 504 tons during the same month last year,—showing an *increase* of 1,040 tons.

Contracts for Coal.—The Admiralty require the supply of 2,700 tons of coal at Fernando Po, and 4,000 tons at St. Paul de Loando.

Metal Markets.

As might be expected at this season of the year the metal market has been dull all through the month, although prices have not undergone any considerable alteration. Only a limited amount of business has been transacted for shipment, and orders for home consumption have been restricted.

Iron.—The iron trade has been tolerably steady during the month and some descriptions have been in fair demand.

The Scotch pig-iron market has been much depressed and prices have receded during the month from 56*s.* 3*d.* to 54*s.* There have been few shipping orders and as stock has to be taken at the end of the year there has been little doing in the way of speculation. The exports during the month were 42,557 against 38,139 tons during the corresponding period last year, showing an *increase* of 4,418 tons.

Welsh bars have been steady, although the demand has not been very

brisk. Prices have not undergone any alteration, and have been quoted 5*l.* 15*s.* to 5*l.* 17*s.* 6*d.* in Wales; and 6*l.* 5*s.* to 6*l.* 10*s.* f. o. b. in London. Staffordshire descriptions have been quiet until towards the end of the month when a fair demand sprung up. Swedish bars have been firmly held and have had rather an upward tendency. The stocks both here and in Sweden are light, and higher prices are anticipated next season. Some sales of ordinary Indian specifications at 11*l.* 10*s.*

STEEL.—Swedish keg remains without alteration at our last quotation of 16*l.*

COPPER.—At the beginning of the month the demand for English both raw and manufactured was decidedly dull, but at the end of the month there was a little improvement, although both raw and manufactured could be obtained under official prices. Foreign has been dull; Burra Burra has been quoted at 99*l.*, Kapunda nominally 100*l.*, Spanish 90*l.*, Chili 88*l.*

YELLOW-METAL.—The demand for this article has been very moderate and prices remain without alteration. Sheathing has been quoted at 9*d.*, although sales have been effected at ½*d.* per lb. under this price. Braziery sheets 8¼*d.* to 8½*d.*

TIN.—Since the arrival of the China mail in the beginning of December there has been a very firm market, although there has been no advance in prices, which remain at our last quotations.

At the beginning of the month a good business was done in foreign, towards the end of the month the demand subsided, holders however remaining firm. Straits 117*l.* cash, 118*l.* full prompt; Banca 119*l.* The Dutch market has been firm at 69 f.

TIN PLATES.—This article remains unaltered in value with a slack demand.

LEAD.—A large business has been done in this article which has been very firm at advanced rates; in the beginning of the month soft English was quoted at 20*l.* 10*s.* to 21*l.* 5*s.*, but at the end of the month there was an advance of 10*s.* English being quoted 21*l.* to 21*l.* 15*s.* W. B. 22*l.*

SPELTER.—The market for this article has been quiet but steady at a slight advance in prices. Several parcels have changed hands at 18*l.* cash, and at the end of the month 100 tons were reported at 18*l.* 5*s.* January delivery. Holders are firm and expect higher prices before long.

Metallic-Ore Markets.

TIN.—There has been no alteration in the tin standard since our last; it therefore remains at—

Superior Fine	£107	Superior Common	£103
Second Fine	105	Second Common	102

The market has been very unsettled, but there is reason to hope that an improvement in the standard will take place before long.

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard have been as follows:—

Date.	*Tons.*	*Produce.*	*Fine Copper.* Tons. cwt.	*Price per ton.*	*Standard.*
Nov 27.	3,602	6¾	243 9	£5 4 6	£118 2 0
Dec. 4.	3,645	6¼	228 4	4 17 6	121 19 0
„ 11.	2,273	7⅜	167 10	5 19 6	118 7 0
„ 18.	5,078	6	302 17	4 16 0	126 16 0

At the sale of the 27th the standard declined 1*l.* 9*s.*; at the sale of December 4th the standard advanced 1*l.* 2*s.*; at the sale of the 11th the standard advanced 1*l.* 2*s.* according to the *West Briton*, but remained stationary according to the *Mining Journal*. At the sale of the 18th according to the *West Briton*, the standard advanced 1*l.* 9*s.*, but according to the *Mining Journal* it advanced only slightly.

Lead.—Comparing the sales of lead ore for the month with those of last month we find that the prices are on an average much the same.

London Share Market.

City, December 27th.

The mining share market for the last month has been generally dull, and the amount of *bonâ fide* business transacted small. At this period of the year business is generally dull; and on the present occasion it has been rendered particularly so by a general want of public confidence arising from the great decline and heavy fluctuations in many prominent market mines.

The principal business has been in *East Caradons*, which have recovered, during the present month, the total decline they suffered last month. They opened quiet at 34*l.*–35, and fluctuated between this price and 36*l.* until the 8th, when they advanced to 37½*l.*–38. From that date they rose steadily, and on the 17th had reached 44*l.* On the 22nd they were 45½*l.*–46½, but close 44¼*l.*–44¾. This rise is principally to be attributed to the extent to which the shares have been oversold, and the consequent scarcity of stock. Until these accounts are closed, the market may be expected to remain in its present feverish and inflated condition. *West Caradons* have been very flat, and have receded in price. They opened at 30*l.*–31, and close at 27*l.*–28. *South Caradons* have also receded from 380*l.*–400 to 375*l.*–385. *Gonamenas* 2*l.*–2½. *South Caradon Wheal Hooper* 17*s.*–19*s.* *Wheal Pollard* 11*s.*–12*s.*

At the beginning of the month a large business was done in *Cargoll*. They opened firm at 30*l.*–32, and continued in demand at advancing prices until the 12th, when they reached 41*l.*–43. After this they were not so firm, and slightly receded in price, closing at 39*l.*–40. *Herodsfoots* opened very firm at 46½*l.*–47½, and have advanced during the month, closing at 49*l.*–50. *Ludcotts* have been flat at receding prices. They opened 10¾*l.*–11, and close at 9½*l.*–9¾. *Wheal Mary Ann* 15½*l.*–16. *Wheal Trelawny* 16¾*l.*–17.

Tincrofts have been in good demand, although prices have not fluctuated much. They were first quoted at 13½*l.*–14. On the 12th they receded to 12¼*l.*–12¾. This depression was caused by the supposition that the shares of Mr. J. G. Tyrie, recently deceased, would be thrown on the market. They recovered again, however, being in good request at 13*l.*–13½, and leave off at 13⅜*l.*–13⅝. *Cook's Kitchen* have advanced in price. They opened 29*l.*–30, on the 13th were very strong at 29*l.*–31, and leave off in demand at 31*l.*–32. *Condurrow* 93*l.*–95. *Dolcoath* 560*l.*–570.

North Croftys opened flat at 4*l.*–4½, but have gradually advanced during the month to 5⅜–5½, at which they have been in demand.

North Roskears have advanced 11*l.* per share during the month. They opened at 36*l.*–37, and close at 47½*l.*–48½ in great demand. *Wheal Emily Henrietta* 9*l.*–9½.

A good deal of business has been transacted in *Wheal Setons*. They opened firm at 165*l.*–170, and gradually advanced until the 19th, when they reached the highest price of 185*l.*–190, after which they were a little flatter, and close at 182½*l.*–187½. *West Setons* have also advanced from 280*l.*–290 to 292*l.*–297. *New Seton* 132½*l.*–135. *South Seton* 25*l.*–30.

Marke Valleys have receded in price. They opened 9½*l.*–10, and close dull at 8¾*l.*–9. *South Phœnix* 2½*l.*–3. *North Phœnix* 6*l.*–6½. *West Rose Down* 16*l.*–18.

South Tolgus has been in demand at advanced prices. Shares opened at 40*l.*–42 in demand, and close at 45*l.*–47½. *Great South Tolgus* opened at 6½*l.*–6¾ flat, but on the 12th advanced to 7*l.*–7¼, at which they close. *Wheal Unions* opened flat at 5¾*l.*–6, and close at 5⅞*l.*–6⅛. *West Tolgus* opened brisk at 51*l.*–53, but receded on the 12th to 49*l.*; on the 22nd they were again much inquired for, and close at 55½*l.*–56½. *Wheal Unys* were inquired for in the beginning of the month at 7*l.*–7½, but on the 11th they became depressed. They have since been more inquired for, and close at 7*l.*–7¼. *South Carn Brea* 3½*l.*–3¾.

East Bassets have been flat through the month: they opened at 51*l.*–52, and close at 50*l.*–52. *North Bassets* have slightly receded, opening at 2¾*l.*–3¼, and closing at 2¾*l.*–2⅞. *South Bassetts* have been more inquired for towards the end of the month: they close at 8*l.*–8½. *Wheal Basset* 80*l.*–85. *West Basset* 14*l.* *Wheal Buller* 50*l.*–55.

East Carn Breas have been largely dealt in, but shares have rather declined. They opened flat at 12½*l.*–13, and on the 12th they receded to 10*l.*–10½, but have since slightly advanced, and close at 11*l.*–11¼. *South Frances*, opened in good demand at the commencement of the month at 90*l.*–95, but have since declined, and close at 90*l.*–93.

Wheal Grenvilles opened in fair demand at 5*l.*–5¼, but close flat at 4¾*l.*–5. *East Grenvilles* have been flat all through the month. They opened at 48*s.*–50*s.*, and close at 44*s.*–46. *West Frances* 12*l.*–13.

Clifford Amalgamated have declined from 21*l.*–23 to 20*l.*–22. *Clijah and Wentworth* 5½*l.*–6. *West Damsel* 75*l.*–80.

Stray Parks opened 43½*l.*–44½ buyers, but on the 12th they were flat at 38*l.*–39, at which they close. *Wheal Harriets* opened at 29*s.*–31*s.*, and have been steadily advancing. They close at 37*s.*–39*s.* *Carn Camborne* 14*s.*–16*s.*

Great Wheal Fortunes opened at 29½*l.* sellers, but later on were in request, and close in good demand at 30*l.*–32. *Wheal Grylls* 31*l.*–33. *Calvadnack* 6*l.*–7.

The Lelant mines have been flat. *Providence* 42*l.*–44. *Wheal Margarets* 41*l.*–43. *Rosewall Hill* and *Ransome United* 3*l.*–3¼. *Wheal Reeth* 37½*l.*–40.

Lady Berthas opened at 25*s.*–30*s.*, and close 25*s.*–27*s.* *Devon Great Consols* 490*l.*–500. *Kelly Bray* 14*s.*–16*s.* *Drake Walls* 17*s.*–19*s.*

North Downs opened at 2½*l.*–2¾, but on the 12th they were more inquired for at firmer prices, and close 2¾*l.*–3. *North Treskerbys* 3¾*l.*–4. *Pendeen Consols* 5*l.*–6. *Wheal Kitty St. Agnes* 4*l.*–4¼. *West Polmear* 5*s.*–7*s.* 6*d.* *Wheal Kitty Lelant* 7½*l.*–8.

Transactions are also reported in the following mines:—*East Rosewarne* 1⅞*l.*–2⅛. *Gurlyn* 2½*l.*–3. *Carn Camborn* 15*s.*–16*s.* *Sortridge Consols*, 9*s.*–10*s.* *Great Retallack*, 14*s.*–16*s.* *West Trevelyan* 8*s.*–10*s.* *Wheal Crebor* 8*s.*–9*s.* *Bottle Hill* 10*s.*–12*s.* *Rosewarne Consols* 3*l.*–3½. *Wheal Unity*, 11*s.*–13*s.* *Worvas Downs* 5*l.*–6. *Trelyon Consols* 10*l.*–12. *Grambler and St. Aubyn*, 15*l.*–17. *East Russell*, 3*l.*–3¼. *East Gunnis Lake and South Bedford* 1½*l.*–1⅝. *East Grylls* 3*l.* *Wheal Pollard* 11*s.*–12*s.* *Wheal Arthur* 8*s.*–10*s.* *Caradon Consols* 14*l.*–15. *Wheal Trerew* 63*s.* *West Stray Park* 3*l.* *Wheal Jane* 13*l.*

In colonial and foreign mines, prices have been quoted as follows:—*Yudanamutana* opened at 3½ and close at 3¼. *Dun Mountain* ¼–⅜. *Scottish Australian* opened at ⅞–1, and close at 1⅛–¼. *Kapunda* 1⅜. *Worthing* ½. *St. John Del Rey* opened at 61–62, but closed at 58–59. *East Del Rey* 1¾–1⅞. *United Mexican* 4⅜–4⅞. *Fortuna* 4. *Lusitanean* 1¾. *Pontigbaud* 2–2⅛. *Santa Barbara* 1¼–1⅜. *Cobre* 19¾–20. *Port Phillip* 1⅛. *Montes Aureos* 2. *Capula* ½.

New undertakings have been quoted at the following prices: *St. Cuthbert* ¼–½ prem. *Nova Scotia* ⅛–⅜. prem. *Dolfrwynog* ¼ dis. to ⅛ prem. *East Cambrian* ⅛–⅜ prem. *Devon and Great Bedford* ½–¾ prem. *Sovereign Gold* ⅛–⅜ prem. *Otea* ⅛–⅜ prem.

Provincial Share Markets.

DUBLIN.—The following is condensed from the *Mining Journal*:—

All through the early part of the month the mining market was very dull, but towards the close a slight improvement took place and a considerable amount of business was done in several mines. *Wicklow Copper* shares have been in good demand at advanced prices: they opened firm at 38*l.* buyers, in the middle of the month they were quoted at 38*l.* 5*s.* with a large business doing and leave off at 38*l.* 10*s.* firmly held. In *Mining Company of Ireland* shares a good deal of business has been done: they were in request in the early part of the month at 19*l.* 10*s.* at which price they remained steady till the end of the month when there was a large amount of business done at 19*l.* 15*s.* *Carysfort* (20*s.* paid) have been done at par. *General Mining Company for Ireland* shares were freely taken in the beginning of the month at 5*l.* 15*s.* but receded to 5*l.* 2*s.* 6*d.*, from which they advanced 5*s.* per share and closing 5*l.* 7*s.* 6*d.* *Connorree* have changed hands at 23*s.*

CORNWALL.—The following is condensed from the *West Briton*:—

The Cornish mine share market has been unusually depressed even for this season of the year. *East Pools* have advanced 15*l.* per share during the month: they opened at 400*l.* 405*l.* and close 415*l.* 420*l.*, at which price there are buyers. *Wendron Consols* have been steady at 11, 11¼. *South Crofty* 12½, 13. *Emily Henriettas* 9, 9½. *Copper Hill* 60, 65. *Trelyon Consols* 12, 12½.

Tabular Abstract of Mining Accounts for the Month.

Date of Meeting.	Name of Mine, and Number of Shares.	Balances. Debit.	Balances. Credit.	Calls. Per Share.	Calls. Total.	Dividends. Per Share.	Dividends. Total.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
	CORNISH AND DEVON MINES.						
Nov. 19	Botallack (200)	—	1,806 14 0	—	—	6 0 0	1,200 0 0
„ 20	Wheal Sithney and Carnmeal (1,048)	2,046 15 0	—	0 10 0	1,024 0	—	—
„ 21	Cargoll (916)	—	1,693 18 1	—	—	1 0 0	916 0 0
„ 21	Wheal Owles (80)	—	4,436 8 9	—	—	7 10 0	600 0 0
„ 24	Rosewarne United (4,096)	765 11 10	—	0 3 9	768 0 0	—	—
„ 25	South Caradon (512)	—	4,693 16 0	—	—	5 0 0	2,560 0 0
„ 25	Wheal Hearle (1,024)	—	225 17 0	—	—	—	—
„ 25	Great Work (119)	935 8 2	—	—	—	—	—
„ 26	West Basset (6,000)	—	5,098 19 2	—	—	—	—
„ 26	East Basset (512)	—	1,265 14 7	—	—	1 0 0	512 0 0
„ 26	Wheal Margaret (896)	—	1,340 0 0	—	—	1 0 0	896 0 0
„ 26	Wheal Agar (6,000)	793 4 6	—	0 5 0	1,500 0 0	—	—
„ 26	East Wheal Russell (4,000)	—	546 1 9	0 2 6	500 0 0	—	—
„ 26	Wheal Edward (4,096)	—	250 0 0	0 2 0	409 12 0	—	—
„ 26	Providence (1,120)	—	1,805 14 11	—	—	1 5 0	1,400 0 0
„ 27	Craddock Moor (1,055)	—	1,171 11 5	—	—	—	—
„ 27	Scorrier Consols (2,000)	379 14 8	—	0 7 6	750 0 0	—	—
„ 27	Gonamena (6,144)	—	217 14 0	0 2 6	768 0 0	—	—
„ 28	Yarner (3,097)	814 12 10	—	0 5 0	774 5 0	—	—
„ 28	Worvas Downs (1,024)	461 3 11	—	0 12 0	614 8 0	—	—
Dec. 2	Wheal Basset (512)	—	1,898 13 5	—	—	2 0 0	1,024 0 0
„ 2	North Treskerby (5,936)	—	755 18 5	—	—	0 1 6	445 4 0
„ 3	Trelyon Consols (572)	631 14 9	—	0 10 0	286 0 0	—	—
„ 3	Wheal Tremayne (1,022)	500 9 5	—	—	—	—	—
„ 4	West Condurrow (1,218)	674 1 0	—	0 11 0	669 18 0	—	—
„ 4	Wheal Polmear (1,024)	—	91 1 6	—	—	—	—
„ 4	Prosper United (6,000)	—	—	1 0 0	6,000 0 0	—	—
„ 4	South Seton (400)	485 19 8	—	2 10 0	1,000 0 0	—	—
„ 4	Great Brigan (5,000)	2,478 3 3	—	0 10 0	2,500 0 0	—	—
„ 5	Great Caradon (4,096)	9 2 11	—	0 2 0	409 12 0	—	—
„ 5	South Wheal Lovell (1,024)	—	—	0 6 0	307 4 0	—	—
„ 5	Clijah and Wentworh (787)	—	356 0 0	0 10 0	393 10 0	—	—
„ 8	Dolcoath (358)	—	3,129 12 6	—	—	7 0 0	2,506 0 0
„ 8	Wheal Seton (396)	—	2,523 16 4	—	—	3 0 0	1,188 0 0
„ 8	Hawkmoor (7,219)	—	184 16 8	—	—	—	—
„ 8	South Crenver (2,283)	1,039 8 10	—	0 11 0	1,255 13 0	—	—
„ 8	Spearne Consols (794)	585 7 6	—	—	—	—	—
„ 9	Wheal Mary Ann (512)	—	2,567 2 9	—	—	0 10 0	256 0 0
„ 9	Wheal Jane (10,000)	202 1 7	—	—	—	—	—
„ 9	West Trevelyan (5,481)	751 1 4	—	0 2 6	685 2 6	—	—
„ 9	Crane (861)	666 15 11	—	1 0 0	861 0 0	—	—
„ 10	Caradon Consols (914)	98 10 9	—	0 12 6	571 5 0	—	—
„ 10	West Par Consols (19,000)	1,374 0 0	—	0 1 0	950 0 0	—	—
„ 10	St. Just United (6,000)	—	—	0 5 0	1,500 0 0	—	—
„ 10	Sortridge Consols (2,000)	104 14 8	—	0 1 0	100 0 0	—	—
„ 10	South Dolcoath and Carnarthen (6,000)	462 19 6	—	0 3 0	900 0 0	—	—
„ 10	Holmbush (10,000)	—	823 17 9	—	—	—	—
„ 11	North Robert (6,144)	503 2 6	—	—	—	—	—
„ 11	South Exmouth (5,000)	—	1,456 9 8	—	—	0 5 0	1,250 0 0
„ 16	West Wheal Seton (400)	—	2,910 9 0	—	—	5 0 0	2,000 0 0
„ 16	Wheal Union (6,000)	381 1 6	—	—	—	—	—
„ 16	Wheal Uny (4,016)	—	18 1 4	—	—	—	—
„ 17	Great Wheal Vor United (5,908)	—	1,934 18 10	—	—	—	—
„ 17	West Caradon (1,024)	—	4,517 6 8	—	—	—	—
„ 18	Great Wheal Baddern (3,730)	871 8 0	—	0 5 0	932 10 0	—	—
„ 18	Great South Tolgus (6,000)	—	1,051 19 0	—	—	—	—
„ 19	Great Retallack (6,000)	659 9 8	—	0 2 0	600 0 0	—	—
	WELSH & OTHER MINES.						
Nov. 24	Brynambor (5,120)	—	89 0 2	0 1 0	256 0 0	—	—
„ 28	South Darren (6,000)	—	452 12 9	—	—	—	—
Dec. 4	Garreg (1,000)	78 1 10	—	0 3 0	150 0 0	—	—
„ 4	Merllyn (4,480)	23 18 3	—	0 1 0	224 0 0	—	—
	FOREIGN MINE.						
Dec. 12	St. John del Rey (11,000)	—	47,203 0 0	—	—	4 0 0	44,000 0 0

Prices Current of Metals.

From Messrs. JAMES and SHAKESPEARE'S, 10, Austin Friars, E.C.

							Per Ton.			
IRON	Bars	in Wales	£5	12	6	@	£5	15	0
	„	„ Liverpool	6	5	0	„	6	10	0
	„	„ London	6	10	0	„	6	17	6
	Nail Rods	„ Wales		——		„	6	5	0
	„ (Staffordshire)	„ Liverpool	6	15	0	„	7	0	0
	„ „	„ London	7	0	0	„	7	10	0
	Hoops „	„ Liverpool	8	0	0	„	8	2	6
	„ „	„ London	8	7	6	„	8	10	0
	Sheets „	„ Liverpool	8	15	0	„	9	5	0
	„ „	„ London	9	5	0	„	9	10	0
	Bars „	„ Liverpool		——		„	7	0	0
	„ „	„ London	7	7	6	„	7	10	0
	Scotch Pig (No. 1. g.m.b.)	the Clyde		——		„	2	14	6
	Rails	in Wales		——		„	5	15	0
	Russian	C.C.N.D.		——		„		——	
	Swedish—Hammered—large sizes			——		„	11	5	0
	„ „	Indian sizes		——		„	11	10	0
STEEL	Hammered—faggot			——		„	16	10	0
	„	in kegs ¼ and ½ in...		——		„	15	10	0
COPPER	Australian and other *fine* Foreign		99	0	0	„	99	10	0
	Foreign Slab, for Prod. 96 per Cent.		88	0	0	„	88	10	0
	English Tile and Tough		96	0	0	„	98	0	0
	„ Best selected		99	0	0	„	101	0	0
	„ Sheets, Sheathing and Rod		102	13	4	„	105	0	0
	„ Flat Bottoms		107	10	0	„	110	0	0
							Per lb.		
YELLOW METAL	Sheets, Sheathing and Rod			——		8¾*d.*		9¼*d.*	
							Per Cwt.		
TIN English	Common Blocks and Ingots			——		„	115*s.*		
	„ Bars (in barrels)			——		„	116*s.*		
	Refined			——		„	120*s.*		
TIN Foreign	Straits, Fine		117*s.* 6*d.*			„	118*s.*		
	Banca		119*s.*			„	120*s.*		
							Per Box.		
TIN PLATES at Liverpool 6*d.* Less	Charcoal IC, best		28*s.* 6*d.*			„	29*s.*		
	„ IX „		34*s.* 6*d.*			„	35*s.*		
	Coke IC		22*s.* 6*d.*			„	24*s.* 6*d.*		
	„ IX		28*s.* 6*d.*			„	30*s.* 6*d.*		
							Per Ton.		
LEAD	Sheet			——		„	£21	10	0
	Pig—W.B.			——		„	22	0	0
	„ Ordinary brands		21	0	0	„	21	5	0
	„ Foreign, soft		20	5	0	„	20	10	0
	Red			——		„	21	15	0
	Shot			——		„	24	0	0
	Dry White			——		„	27	10	0
SPELTER	(Cake)			——		„	18	0	0
ZINC	(Sheet)			——		„	23	10	0
							Per Bottle.		
QUICKSILVER	(in bottles containing 75lbs. each)			——		„	7	0	0
							Per Ton.		
REGULUS OF ANTIMONY	French Star			——		„	43	0	0

The Metal Market has been quiet during the last ten days, but prices for one or two articles are a shade better.

COPPER.—A little more business doing both in English and Foreign, the latter is a trifle higher.

TIN.—More inquiry for English, and Straits is firm at quotations.

There was no Price Current issued on the 26th; and being Christmas week there has been no material alteration in prices.

Copper Ores.

Sampled Nov. 12, and sold at Tabb's Hotel, Redruth, Nov 27.

Mines.	Tons.	Purchasers.	Price.
South Caradon	110	2	£5 9 0
	93	5	9 1 0
	77	5	8 8 0
	63	1	17 5 6
	49	7	7 19 0
	48	1	6 15 6
	45	1, 5	2 1 6
	30	7	6 0 0
West Caradon	82	9	7 0 6
	69	9	8 4 0
	68	9	5 5 6
	67	2	6 17 6
	66	1, 5	9 18 0
	62	9	4 13 0
	38	10	4 5 0
North Treskerby	62	3	6 5 0
	59	7	4 10 0
	58	5	5 14 0
	57	7	4 10 0
	56	7	4 14 6
	55	3	5 13 6
	46	3	6 16 6
	44	7	2 12 6
Great Wheal Busy	78	9	3 0 6
	77	10	2 6 6
	65	8	4 1 0
	47	10	2 18 0
	45	9	3 8 0
	41	8	6 17 0
	40	10	1 19 6
	27	5	2 2 0
Clifford Amalgamated (United Mines)	58	5	2 3 0
	57	3	5 10 6
	56	1	1 8 0
	55	5	3 13 0
	50	10	0 10 6
	44	3	5 8 0

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	40	8, 12	£3 1 6
	20	5	3 7 6
Fowey Consols	71	1, 5, 10	4 11 6
	70	9	4 8 6
	68	1, 5	5 15 6
	61	1	4 10 6
Tywarnhaile	61	9	2 5 6
	59	8	2 12 0
	54	5, 13	2 3 0
	46	13	6 7 6
North Downs	62	3	6 8 6
	57	3	7 8 6
	56	8, 9	3 10 0
	32	9, 10	2 9 0
Craddock Moor	65	1, 5	5 15 6
	44	1, 5	5 18 6
	26	2	5 4 0
	25	1, 5	1 15 6
Wheal Polmear	60	10	3 10 0
	55	5	3 17 0
	25	6	9 2 6
St. Day United	53	7	4 6 0
	32	3	2 4 0
South Crinnis	37	2	3 12 0
	36	9	3 15 0
Burra Burra	24	1	2 14 6
	21	8	3 17 0
Wheal Jane	26	1, 5	2 19 0
	16	1, 5	4 1 6
Bampfylde	42	1, 8	13 14 6
Wheal Prudence	37	5	2 12 6
Trenouth's Ore	27	5	2 1 6
Perran Mines	24	5	3 5 0
Wheal Henry	13	1	4 3 6
Wheal Damsel	9	6	4 19 0
Wheal Leisure	4	12	2 6 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
South Caradon	515	£4,644 8 0
West Caradon	452	3,064 7 6
North Treskerby	437	2,246 5 6
Great Wheal Busy	420	1,384 1 6
Clifford Amalgamated	390	1,173 2 6
Fowey Consols	270	1,303 6 0
Tywarnhaile	220	701 10 6
North Downs	207	1,095 19 6
Craddock Moor	160	815 13 0
Wheal Polmear	140	649 17 6
St. Day United	85	298 6 0

	Tons.	Amount.
South Crinnis	73	£268 4 0
Burra Burra	45	146 5 0
Wheal Jane	42	141 18 0
Bampfylde	42	576 9 0
Wheal Prudence	37	97 2 6
Trenouth's Ore	27	56 0 6
Perran Mines	24	78 0 0
Wheal Henry	13	54 5 6
Wheal Damsel	9	44 11 0
Wheal Leisure	4	9 4 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	487¼	£3,745 0 9
2 Freeman and Co.	240	1,328 10 6
3 Grenfell and Sons	415	2,458 1 6
4 Crown Copper Co	—	—
5 Sims, Willyams & Co.	759½	3,858 16 9
6 Williams, Foster & Co.	34	272 13 6
7 Mason and Elkington	348	1,699 11 0
8 Bankart and Sons	255	1,226 1 6

	Tons.	Amount.
9 Copper Miners' Co.	615	£2,898 10 6
10 Charles Lambert	351¾	939 11 0
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	24	70 14 0
13 Neath Copper Co.	73	351 6 0
Total	3602	£18,848 17 0

Average Produce, 6¾.
Quantity of Fine Copper, 243 tons 9 cwt.

Average standard £118 2 0
Average Price per ton 5 4 6

Copper Ores.

Sampled Nov. 19, and sold at Tabb's Hotel, Redruth, Dec. 4.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	102	1	£5 1 0
(Wheal Clifford)	101	1	6 7 6
	98	3	6 14 6
	92	2	5 0 0
	90	1	4 11 6
	75	5, 9	3 7 6
	70	12	3 10 6
	67	5	3 16 0
	55	3	5 16 0
	54	8	5 10 6
	38	1	4 8 0
	36	3	5 4 6
(Consols)	56	3	7 8 0
	26	3	5 11 6
West Seton	81	9	2 13 6
	74	1, 3, 5	7 4 0
	68	8	5 15 0
	66	9	6 8 6
	65	7	6 6 0
	57	3	6 7 0
	54	5	5 5 0
	53	8	5 1 6
	39	1, 5	0 6 6
	36	3	7 11 6
East Pool	80	2, 9	5 3 6
	74	8	4 12 0
	62	10, 12	2 8 0
	45	2	4 3 0
	37	10	3 18 6
	35	1, 5	0 2 0
	27	6	4 10 6
Wh. Seton (Pendarves)	73	7, 13	5 18 6
	66	7	5 10 0
	61	9	3 18 0
	55	8	1 3 6
	29	3	13 17 0
Condurrow	76	10	1 6 0
	73	7	2 10 0
	56	9	5 16 6

Mines.	Tons.	Purchasers.	Price.
Condurrow	48	7	£1 13 6
	8	7	6 12 0
Tincroft	56	5	5 13 0
	49	5	1 13 0
	42	10	1 15 0
	30	6	4 15 6
	20	3	9 7 6
South Tolgus	49	5, 10	3 5 0
	48	5	6 12 0
	47	1, 5, 10	3 3 0
	42	3	6 3 6
Wheal Basset	66	12	5 2 6
	50	1, 5	4 4 6
	29	7	9 8 0
	24	7	6 7 6
	1	1	50 0 0
South Frances	60	1, 5	4 10 6
	39	8	5 1 6
	33	1, 5	6 0 6
	17	1, 5	8 13 6
	5	1	4 8 0
Dolcoath	42	1	9 5 6
	38	12	3 19 0
	32	6	5 2 0
East Basset	48	7	5 17 0
	31	2, 5	4 0 0
	21	5	5 7 0
Stray Park	43	5	3 2 0
	29	3	8 11 0
Camborne Vean	37	9	3 12 6
	24	1	8 6 0
South Crofty	31	10	1 9 0
	21	5	7 14 0
South Basset	28	7	2 14 6
Wheal Moyle	16	1, 5	2 1 6
	5	5	2 8 6
Wheal Henrietta	18	3, 6	7 8 0
Crane	10	1	7 16 6
	1	1	2 15 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amalgamated	960	£4,976 5 0
West Seton	593	3,173 16 6
East Pool	360	1,360 17 0
Wheal Seton	284	1,499 14 0
Condurrow	261	740 14 0
Tincroft	197	801 10 0
South Tolgus	186	883 9 0
Wheal Basset	170	1,025 2 0
South Frances	159	867 17 0

	Tons.	Amount.
Dolcoath	112	£702 17 0
East Basset	100	517 3 0
Stray Park	72	381 5 0
Camborne Vean	61	333 6 6
South Crofty	52	206 13 0
South Basset	28	76 6 0
Wheal Moyle	21	45 6 6
Wheal Emily Henrietta	18	133 4 0
Crane	11	81 0 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	581 5-6	£3,160 12 6
2 Freeman and Co.	192½	915 15 0
3 Grenfell and Sons	517¾	3,700 16 0
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	609½	2,621 6 9
6 Williams, Foster & Co.	98	495 4 6
7 Mason and Elkington	425½	2,087 3 3
8 Bankart and Sons	343	1,561 5 6

	Tons.	Amount.
9 Copper Miners' Co.	378¼	1,672 10 3
10 Charles Lambert	257½	565 17 0
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	205	802 10 0
13 Neath Copper Co.	36½	216 5 3
Total	3645	£17,806 6 0

Average Produce, 6¼.
Quantity of Fine Copper, 228 tons, 4 cwt.

Average Standard £121 19 0
Average Price per ton 4 17 6

Copper Ores.

Sampled Nov. 26, and sold at Tabb's Hotel, Redruth, Dec. 11.

Mines.	Tons.	Purchasers.	Price.
West Basset	75	7	£4 6 0
	74	1	4 10 6
	69	1, 5	4 8 6
	65	1, 2	10 0 6
	59	1, 5	9 1 0
	58	1	5 4 6
	39	9	5 5 6
	31	3	8 2 6
Par Consols	66	8	6 6 6
	62	1	11 5 0
	61	6	6 17 0
	50	10	4 0 6
Carn Brea	72	2, 3	6 13 0
	61	5, 10	3 12 0
	48	5, 7	4 3 6
	47	5, 7	4 5 6
Prosper United	64	1, 5, 7	4 12 0
	54	1	3 0 6
	33	5, 7	5 1 0
	24	5	3 15 0
Great South Tolgus	51	3	8 9 0
	48	3	5 10 0
	41	3	10 18 0
Pendeen Consols	77	5	3 8 0
	50	2, 5	3 19 6
	3	5	22 18 6
Botallack	88	7	7 11 6
	19	2	8 7 0

Mines.	Tons.	Purchasers.	Price.
Botallack	12	1	£10 17 6
Treloweth	61	9	4 9 6
	20	6	5 19 0
	14	1, 6	12 9 6
Rosewarne Consols	46	5	10 3 0
	38	5	7 17 6
	10	8	4 6 6
Rosewarne United	47	3	4 10 0
	27	3	10 8 6
	12	3, 6	7 3 0
Wheal Uny	44	6	6 7 6
	35	3	8 11 0
Copper Hill	34	10	1 16 6
	24	7	8 5 0
	12	3, 7	15 6 0
Wheal Anna	65	6	5 12 6
West Alfred Consols	45	7, 10	0 18 0
	13	5	1 15 0
Charlotte United	43	6	7 6 0
	15	8	2 8 6
Wheal Buller	42	2, 3	3 6 6
	14	3	12 3 0
Great Wheal Alfred	47	9	2 0 6
Wheal Vyvyan	25	5	1 18 0
	10	5	9 14 6
Camborne Consols	12	9	8 16 6
West Tolvadden	11	12	4 0 0
South Dolcoath	3	3	9 5 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
West Basset	470	£2,908 18 0
Par Consols	239	1,734 1 0
Carn Brea	228	1,099 14 6
Prosper United	175	714 8 0
Great South Tolgus	140	1,141 17 0
Pendeen Consols	130	519 6 6
Botallack	119	955 15 0
Treloweth	95	566 12 6
Rosewarne Consols	94	809 8 0
Rosewarne United	86	578 15 6
Wheal Uny	79	579 15 0

	Tons.	Amount.
Copper Hill	70	£443 13 0
Wheal Anna	65	365 12 6
West Alfred Consols	61	65 19 0
Charlotte United	58	350 5 6
Wheal Buller	56	309 1 0
Great Wheal Alfred	47	95 3 6
Wheal Vyvyan	35	144 15 0
Camborne Consols	12	105 18 0
West Talvadden	11	44 0 0
South Dolcoath	3	27 15 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	384 5-6	£2,560 3 2
2 Freeman and Co.	133½	892 10 9
3 Grenfell and Sons	366	2,827 11 0
4 Crown Copper Co	—	—
5 Sims, Willyams, & Co.	440 5-6	2,365 3 2
6 Williams, Foster & Co.	246	1,627 2 0
7 Mason and Elkington	302½	1,682 12 5
8 Bankart and Sons	91	497 1 6

	Tons.	Amount.
9 Copper Miners' Co.	159	£679 15 6
10 Charles Lambert	138½	394 14 0
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	11	44 0 0
13 Neath Copper Co.	—	—
Total	2273	£13,570 13 6

Average Produce, 7¾.
Quantity of Fine Copper, 167 tons, 10 cwts.

Average Standard £118 7 0
Average Price per ton 5 19 6

Copper Ores.

Sampled Dec. 3, and sold at the Royal Hotel, Truro, Dec. 18.

Mines.	Tons.	Purchasers.	Price.
Devon Great Consols	132	5	£4 16 0
	128	7	4 10 0
	124	7	4 10 0
	123	2	4 19 0
	119	11	5 9 6
	114	9	4 13 0
	111	9	3 19 6
	109	12	3 14 6
	106	5	4 9 0
	102	3	9 5 0
	97	3, 6, 9	4 15 6
	94	6	4 19 6
	91	8	5 8 6
	88	1	10 11 6
	85	10	2 5 0
	76	8	2 13 6
	74	10	4 4 0
	72	1	4 14 6
	62	3, 6	6 10 0
	49	10	2 10 6
	48	6	4 19 6
	45	2	2 15 6
Phœnix Mines	85	1	4 4 6
	80	5	3 17 0
	79	1	2 16 6
	78	8	2 8 0
	70	8	3 9 0
	63	3	8 17 0
	43	7	3 3 0
East Caradon	95	6	4 6 6
	91	6	4 14 0
	89	9	5 9 0
	75	1	9 11 6
	60	9	7 16 0
	55	3	13 4 0
Marke Valley	93	1	2 19 6

Mines.	Tons.	Purchasers.	Price.
Marke Valley	82	6, 12, 13	£3 19 6
	71	6	3 19 0
	70	2	3 18 0
	63	8	3 10 0
	51	1	2 8 0
Devon and Cornwall	85	7, 10	2 1 6
	84	8	2 4 0
	76	3	2 6 0
	44	6	10 8 6
	19	3	9 4 6
Wheal Crelake	78	6, 7	2 17 6
	67	6	6 7 6
	66	3, 7	4 10 6
	39	6	5 19 6
Bedford United	112	6	3 15 6
	100	3, 6, 13	4 12 6
Wheal Friendship	71	6	6 7 6
	70	6	11 6 6
Wheal Emma	61	1	3 1 0
	53	5	7 1 0
	23	1	1 7 6
North Robert	70	12	1 10 6
	53	5	9 12 0
Wheal Yarner	76	5	2 15 6
	44	5	4 9 6
Sortridge Consols	41	2	6 10 6
	32	7	5 0 0
Wheal Arthur	48	7, 12	1 12 6
	22	7	4 8 6
Brookwood	54	6	5 10 0
	12	6	7 13 6
Lady Bertha	61	3	3 10 6
Fursdon	33	11	4 14 6
Hawkmoor	24	3	4 19 0
Tavy Consols	19	7	3 5 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2,049	£10,111 11 6
Phœnix Mines	498	1,969 0 0
East Caradon	465	3,235 15 0
Marke Valley	430	1,498 19 6
Devon and Cornwall	307	1,160 14 6
Wheal Crelake	250	1,183 1 0
Bedford United	212	885 6 0
Wheal Friendship	141	1,245 7 6
Wheal Emma	137	591 6 6

	Tons.	Amount.
North Robert	123	£615 11 0
Wheal Yarner	120	407 16 0
Sortridge Consols	73	427 10 6
Wheal Arthur	70	175 7 0
Brookwood	66	389 2 0
Lady Bertha	61	215 0 6
Fursdon	33	155 18 6
Hawkmoor	24	118 16 0
Tavy Consols	19	62 4 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	627	£2,187 19 6
2 Freeman and Co.	279	1,274 5 0
3 Grenfell and Sons	528⅜	3,561 2 2
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	544	2,703 11 0
6 Williams, Foster & Co.	1031	5,732 8 8
7 Mason and Elkington	506½	1,934 13 3
8 Bankart and Sons	462	1,530 19 6

	Tons.	Amount.
9 Copper Miners' Co.	406½	£2,078 15 4
10 Charles Lambert	250½	713 19 3
11 Newton, Keates & Co.	152	807 9 0
12 Sweetland, Tuttle & Co.	250½	660 8 6
13 Neath Copper Co.	60⅜	262 16 4
Total	5078	£24,448 7 6

Average Produce, 6.
Quantity of Fine Copper, 302 tons 17 cwt

Average Standard £126 16 0
Average Price per ton £4 18 0

Copper Ores.

Sampled Nov. 26, and sold at Swansea, Dec. 16.

Mines.	Tons.	Produce.	Purchasers.	Price.
Knockmahon ...	68	10¼	6	£9 9 0
	67	10¼	6	9 9 0
	60	10⅞	6	9 8 0
	58	11½	6	9 14 0
	62	11¼	6	10 0 0
	60	11½	6	10 5 0
Genoa	99	8¾	5	7 0 6
	23	7¼	7	6 9 6
	12	6¼	15	5 1 6
	5	9½	7	7 15 0
Berehaven 120		11	7	9 11 6
Wheal Maria ...	53	38	2	31 9 0
Ookip	46	33½	7	29 18 0
Laxey	82	6¼	7	5 5 0
French Slag ...	53	6⅝	5	£4 14 0
Seville	41	10⅛	7	8 1 6
	5	23	7	20 2 0
	4	14½	7	12 12 0
Canobolas	47	14½	7	12 3 0
New Cornwall...	40	26½	2, 7	23 11 0
African	25	28½	10	24 5 6
	7	24⅝	14	20 12 0
British Regulus	26	36	7	31 15 0
Connorree Rids.	18	3	7	2 2 0
Precipitate	8	67½	5	56 12 0
Glo'ster Slag ...	4	48½	6	38 0 0
West Kame	6	5½	10	4 10 0
London.....	4	47½	3	41 0 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Knockmahon	375	£3,637 7 0
Genoa	139	944 1 0
Berehaven	120	1,149 0 0
Wheal Maria	53	1,666 17 0
Ookip	46	1,375 8 0
Laxey	82	430 10 0
French Slag.....	53	249 2 0
Seville	50	481 19 6
Canobolas	47	£571 1 0
New Cornwall	40	942 0 0
African	32	751 1 6
British Regulus	26	825 10 0
Connorree	26	490 12 0
Glo'ster Slag.....	4	152 0 0
West Kame	6	27 0 0
London	4	164 0 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Copper Miners' Co.	—	——
2 Freeman and Co.....	73	£2,137 17 0
3 Grenfell and Sons	4	164 0 0
4 Crown Copper Co.	—	——
5 Sims, Willyams & Co.....160		1,397 7 6
6 Vivian and Sons 379		3,789 7 0
7 Williams, Foster & Co. ...437		5,529 18 0
8 British and For. Copper Co.	—	——
9 Mason and Elkington ...	—	——
10 Bankart and Sons	31	£633 17 0
11 Charles Lambert	—	——
12 Ravenhead Copper Co....	—	——
13 Sweetland, Tuttle & Co.	—	——
14 Jennings & Co.	7	144 4 0
15 Neath Copper Co.	12	60 18 0
Total	1103	£13,857 9 0

Sundry Copper Ore Sales.

Date.	Mines.		Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Dec. 1.	ex Magellan	Lot 1	65 ...	23 10 1 ...	Williams, Foster & Co.	
		2	67 ...	23 5 9 ...	ditto	
		3	67 ...	23 12 6 ...	Bibby, Son & Co.	
		4	67 ...	23 13 10 ...	Williams, Foster & Co.	
		5	68 ...	23 9 7 ...	ditto	
		6	68 ...	23 4 6 ...	Bibby, Son & Co.	
		7	68 ...	23 3 6 ...	St. Helen's Co.	20235 2 0
		8	68 ...	23 6 6 ...	Bibby, Son & Co.	
		9	68 ...	23 14 4 ...	Williams, Foster & Co.	
		10	68 ...	23 11 9 ...	ditto	
		11	68 ...	23 12 0 ...	J. P. Campbell	
		12	68 ...	23 12 0 ...	ditto	
		13	68 ...	23 14 4 ...	Williams, Foster & Co.	
,, 19.	Parys Mines	Lot 1	100 ...	5 19 0 ...	St. Helen's Co.	1190 0 0
		2	100 ...	6 19 0 ...	Mona Co.	
,, 20.	,,	Lot 1	105 ...	5 19 0 ...	C. Lambert, Mona Co.	
		2	80 ...	6 3 6 ...	ditto	
		3	30 ...	2 7 0 ...	ditto	
		4 (precipitate)	21 ...	11 3 6 ...	Sims, Willyams & Co....	1522 5 6
		5 (precipitate)	14 ...	2 18 0 ...	C. Lambert	
		6 (precipitate)	10 ...	8 16 6 ...	Newton, Keates & Co.	

Copper Ores.

Sampled Nov. 12, and sold at Swansea Dec. 2.

Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	104	13¾	6	£11 9 0
	102	13¾	2	11 10 6
	100	13¾	7	11 3 6
	87	13¼	7	11 13 6
	42	20¼	9	17 7 0
	40	19¾	9	17 0 0
	12	56	10	47 7 6
	96	13¾	6	11 10 0
	92	14	6	11 6 0
	91	13¾	6	11 12 0
	90	13¾	7	11 9 0
	86	13¾	7	11 11 0
	82	13¾	8, 7	11 6 0
Cobre	79	14¼	3	£11 15 0
	41	24¾	3	20 10 0
	37	24¾	3	20 10 0
	17	58¼	5	48 11 0
Ookip	51	33¾	5	28 16 0
	49	34	11	28 13 6
	48	34¼	11	28 9 6
	47	34	3	28 13 0
Wheal Maria	59	39¼	2	33 7 0
	57	39½	13	33 9 0
Berehaven	82	10	6	8 11 0
Lochwinnoch	14	9½	6	8 8 0
Dun Mountain	43	1½	5	0 11 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Cobre	1,198	£15,976 16 0
Ookip	195	5,587 4 6
Wheal Maria	116	3,874 6 0
Berehaven	82	£701 2 0
Lochwinnock	14	117 12 0
Dun Mountain	43	24 14 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Copper Miners' Co.	—	—
2 Freeman and Co.	161	£3,143 4 0
3 Grenfell and Sons	245	4,337 2 0
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	111	2,318 17 6
6 Vivian and Sons	479	5,208 14 0
7 Williams, Foster & Co.	404	4,618 3 0
8 British and For. Copper Co.	—	—
9 Mason and Elkington	82	1,408 14 0
10 Bankart and Sons	12	£568 10 0
11 Charles Lambert	97	2,771 17 6
12 Ravenhead Copper Co.	—	—
13 Sweetland, Tuttle & Co.	57	1,906 13 0
14 Jennings and Co.	—	—
15 Neath Copper Co.	—	—
Total	1648	£26,281 15 0

Black Tin Sales.

Date.	Mines.	Tons. c. q. lbs.	Price per ton £ s. d.	Purchasers.	Amount of Money. £ s. d.
Nov. 20.	Wheal Vyvyan	1 9 2 4	64 0 0	Enthoven and Sons	109 8 9
	"	0 6 2 15	45 0 0	ditto	
	Trevenen	8 12 0 26	71 0 0	ditto	655 9 8
	"	1 0 0 3	44 0 0	ditto	
	Par Consols	26 4 0 0	69 12 6	—	1824 3 6
	West Fowey Consols	13 16 0 0	68 15 0	—	948 15 0
" 22.	South Carn Brea	4 18 1 27	61 15 0	Bissoe Co.	618 0 4
	"	5 1 2 20	61 15 0	Trethellan Co.	
	Leeds and St. Aubyn	3 0 2 10	65 0 0	ditto	233 4 0
	"	0 13 0 16	56 0 0	ditto	
	West Beam	10 4 3 5	71 0 0	Calenick	727 0 4
	Drake Walls	9 0 0 0	69 2 6	Michell & Co.	1744 2 6
	"	17 0 0 0	66 0 0	ditto	
" 26.	St. Day United	37 15 0 24	—	—	2142 18 4
" 28.	Cuddra	3 19 2 21	64 7 6	—	266 15 7
	"	0 3 3 9	48 10 0	—	
" 29.	St. Just United	5 15 2 24	68 15 0	Chyandour Co.	397 15 0
	Atlas	2 1 0 25	61 0 0	Trethellan Co.	125 14 7
Dec. 1.	Great Wheal Busy	21 10 2 14	—	Bissoe Co.	1254 0 6
" 6.	Polhigey Moor	3 7 2 20	61 7 6	Calenick Co.	214 10 10
	"	0 4 3 7	28 10 0	ditto	
" 13.	Gt. Wh. Vor United	40 3 3 2	—	—	2736 18 6
	Kitty (St, Agnes)	7 2 2 18	—	R. Michell and Co.	873 16 9
	"	6 12 0 0	—	Chyandour Co.	
	Wheal Union	2 4 3 15	60 10 0	Bissoe Co.	150 9 6
	"	0 4 2 13	62 10 0	ditto	
" 15.	Gurlyn	6 7 3 23	62 10 0	Mellanear Co.	399 17 0

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Nov. 21.	Llanfair	42	28 11 0	Treffry's Trustees	1374 15 6
	"	41	28 13 6	ditto	
" 24.	Dyliffe	64	13 14 0	Adam Eyton	876 16 0
" 27.	Mount Pleasant	10	12 16 0	ditto	128 0 0
	Bryngwyn	10	13 17 6	ditto	133 15 0
	Hendre Ucha	26	13 9 0	Walker, Parker & Co.	505 19 0
	"	10	14 12 6	Newton, Keates & Co.	
	Dyliffe	76	13 14 6	Walker, Parker & Co.	1043 2 0
	Caeconroy	12¼	14 14 0	A. Courage and Co.	183 15 0
	Llanerchyraur	13	14 6 6	Walker, Parker & Co.	186 4 6
	Roman Gravels	30	13 15 0	Adam Eyton	412 10 0
	Llanfyrnach (Pembroke)	30	14 17 6	Panther Co.	495 15 0
	"	6	8 5 0	ditto	
	Carmarthen United	30	14 3 0	Sims, Willyams & Co.	424 10 0
" 29.	Herodsfoot	85	26 16 6	Michell & Son	2278 0 0
Dec. 1.	East Logylas	55	12 16 6	Walker, Parker & Co.	204 16 0
	Glogfach	60	15 15 6	ditto	945 0 0
	Cwmystwith	50	13 2 6	Panther Co.	1313 15 0
	"	50	13 3 0	ditto	
	Goginan	28	18 4 0	Treffry's Trustees	642 12 0
	"	8	16 12 6	ditto	
" 2.	Dyliffe	38	13 11 0	A. Courage and Co.	514 18 0
" 3.	Laxey	100	17 18 0	Adam Eyton	1790 0 0
" 4.	North Porthilly	7	13 4 6	Treffry's Trustees	98 0 0
	"	1	5 8 6	ditto	
	South Exmouth	90	12 14 0	Sims, Willyams & Co.	1143 0 0
" 5.	Minera	106	13 7 0	Adam Eyton	9002 7 0
	"	105	13 6 6	Walker, Parker & Co.	
	"	105	13 6 6	ditto	
	"	100	13 3 6	Newton, Keates & Co.	
	"	100	13 10 0	Panther Co.	
	"	100	13 12 0	Adam Eyton	
	"	56	13 12 0	ditto	
" 6.	Harwood	20	12 12 6	Washington Co.	252 10 0
	Wheal Mary Ann	57	29 7 6	Treffry's Trustees	1674 7 6
" 8.	Dyfngwm	47	13 6 6	Walker, Parker & Co.	859 9 3
	"	17½	13 6 6	Newton, Keates & Co.	
	Rhoswydol	8	12 15 0	ditto	102 0 0
	Aberdovey	16	12 18 0	A. Courage and Co.	206 8 0
" 11.	Talargoch (Maesyrerwddu)	49½	14 5 6	Newton, Keates & Co.	1720 18 0
	" (Coetia Llys)	32¼	14 3 6	ditto	
	" "	32¼	14 3 6	Adam Eyton	
	Deep Level	8	12 15 6	A. Courage and Co.	102 4 0
	Rhosesmor	50	13 1 6	Walker, Parker & Co.	653 15 0
	Parry's	42	13 11 0	ditto	567 0 0
	Bryn Gwiog	40	13 18 6	ditto	557 0 0
	Long Rake	10	13 5 0	ditto	132 10 0
	Merllyn	3	11 5 0	ditto	67 10 0
		3	11 5 0	A. Courage and Co.	
	Grosvenor	3½	11 8 0	Adam Eyton	39 18 0
	Pennant	1	14 14 6	ditto	199 14 6
	"	8	13 7 6	Newton, Keates & Co.	
	"	6	13 0 0	ditto	
	Cefn Cilcen	5	13 0 6	ditto	65 2 6
	Llangynog United	23	12 15 6	ditto	293 16 6
	Roman Gravels	20	13 2 6	ditto	—
	North Minera	40	12 17 6	ditto	515 0 0
	Minera Union	12	12 16 0	Adam Eyton	153 12 0
" 15.	Frongoch	126	13 2 0	Sims, Willyams & Co.	1650 12 0
	East Darren	95	15 16 0	Newton, Keates & Co.	1453 10 0
	Cwm Erfin	25	16 6 6	R. Mitchell and Son	892 12 6
	"	30	16 3 0	Sims, Willyams & Co.	

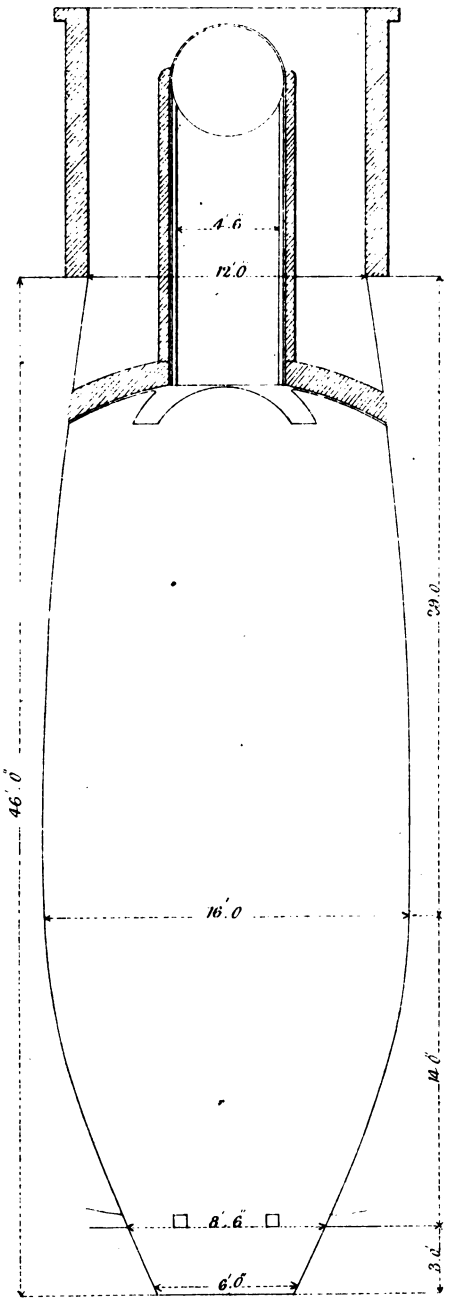


Fig. 1.

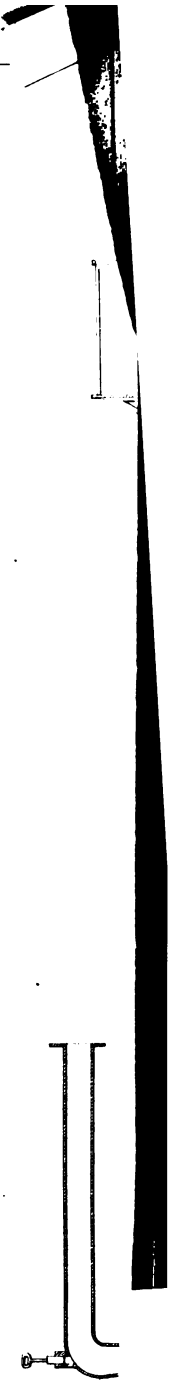


Fig.

THE

NG AND SMELTING MAGAZINE.

FEBRUARY, 1863.

ertiary Bituminous Coal in Transylvania, with e Notice of the Brown Coals of the Danube.

By Professor D. T. Ansted, M.A., F.R.S.

is crossed by the Danube and its tributaries are rich in iel. The deposits generally occur in detached lenticular ore or less resembling regularly deposited beds, and gene- ist of a very excellent quality of brown coal, capable of l not only for household purposes but for steam-boats and es, and even for gas and iron making. There are several districts each yielding from seventy to a hundred thousand nnum, and until the discovery of the lias coals, which are wherever they can be obtained, the brown coal was the able fuel. It is black with a brownish streak, cubical, not l with ash, not much troubled with pyrites; it burns freely, isagreeable odour, and with a long flame. It has however that connect it with other brown coals and take much alue. Although compact, dry, and clean in the bed and led with water, it is found to contain a large and variable e of water not removable by air drying, and when taken e earth and exposed to weather it breaks up into small l these again fall to powder within a few weeks in summer. rinter it is difficult to preserve it, under cover and with all as, more than a very few months, so that practically it e stored, and it is only removed from the mine as it is o supply an immediate demand for consumption. This much with its value in an economic sense.

eposits containing this coal are referred to the newer part ocene period. They overlie the great salt deposits which id are worked on the flanks of the Carpathians, and these rlie the newer Carpathian sandstones which are of Eocene s in many other districts, the rocks containing the brown

coal are for the most part mere sandstones and clays, of loose texture and rich in calcareous matter. They fall to powder on exposure to the air and they contain no irony or calcareous nodules. When traced to a distance most of the coal deposits are found to thin out and die away altogether, not being connected with other deposits that may exist at a short distance on the same geological horizon. This is especially the case with the thicker beds, which are lenticular masses rarely extending far. In many places there is a certain practical and easily ascertained limit to the coal deposits, although the exact number may not seem capable of definition. The coal-bearing part of the series is terminated upwards by a shelly marl loaded with a species of *Cerithium*. The whole coal-bearing series has its regular strike and dip, and the beds of coal are generally at the same or nearly the same distance asunder. Near and under the coal are beds containing a species of *Dentalium*, but except in the cases alluded to fossils seem to be very rare.

The whole thickness of the Miocene rocks of the Danube is very great, and the deposit recurs on the other side of the Carpathians, in Moldavia, and in Bessarabia; but it is largely covered with newer tertiaries. The coal has only been found and worked in a few localities compared with the extent of the rock. This is partly no doubt because the mineral can have no value economically except in places to which there is ready access and a navigable stream or railway to convey it to a market.

In Hungary there are extensively worked mines of it at Oedenburg near Vienna, connected with that city by rail, others near Gran on the Danube, and others on the Theiss. In Moravia and Styria nearly half a million of tons per annum are raised and consumed. In all the coals from 8 to 16 per cent. of water is a constituent part of the mineral, even in the most valuable and most extensively worked deposits, while the general average of a large number of the Austrian brown coals forwarded by the Geological Institute of Austria to the International Exhibition is as much as 15 per cent., and the average percentage of ash, is nine per cent.

In considering these deposits with reference to their probable origin it is necessary to look to various conditions. The underlying and overlying rocks are so little altered—they are still such mere masses of half dried lake mud—that it is difficult to understand how the coal has been formed. It is entirely without woody fibre and has probably been drifted in a greatly decomposed state and accumulated under water. The vegetable matter, however deposited, has since undergone a great change, although the muds accumulated before and after are very little altered. The nature of this change is indicated by the observations of Mr. Wall on the Trinidad bitumens.

The tertiary deposits of the plains of the Danube are not repeated in the smaller mountain valleys of the Carpathians. Many of these valleys contain gravels belonging to a late period although they are now at a high level. Beneath them are others of older date but also tertiary. Auriferous gravels are common in such localities and some of them are certainly of two distinct periods: the main source of the supply being several hundred feet above the gravels

now occupying the valleys, and these are again forty or fifty feet above the water level. Lastly the present bed of the valley is perhaps one or two thousand feet above the sea.

The valley of the Zsil—one of the most remarkable of these—is situated in the heart of the Southern Carpathians between Retgezat and Barang, two principal mountains of the Southern Carpathians, each nearly nine thousand feet high. The valley is about twenty miles long from west to east and five miles wide at the eastern extremity, narrowing gradually towards the west. The greater part of this valley is occupied by disturbed but nearly horizontal thick-bedded sandstones and conglomerates. Between these and the secondary limestones, or metamorphic rock of the mountains adjacent, is a middle or older tertiary series quite unconformable with the sandstones just alluded to, dipping at a high angle on each side towards the centre of the basin, and cropping at intervals all round between the more horizontal beds and the mountains. The rocks met with are hard compact grits and sandstones, durable shales and bands of ironstone, together with a number of seams of excellent bituminous coal.

There are twelve well-defined workable beds of coal, one of them from thirty to fifty feet thick, four others varying from five to ten feet, and the rest between two and five feet thick. Almost all the seams repose on sandstone, but have shales not far off—many of them have shale roofs, most of them have black shale partings of an inch or two in thickness.

Of these coal beds two are particularly well marked, occurring always immediately beneath a shaly bed loaded with *Cerithia*, all in a rotten state and apparently limited to one or two species. The seams thus marked are the third and tenth from the top, the tenth being the thick coal. Above the Cerithium bed, over the thick coal and immediately beneath that seam, are ironstone bands from ten to fifteen inches thick, rich in iron and very constantly met with in the same relative position and of the same thickness.

There is an excellent section of the coal shown in a valley on the north side of the Zsil Valley.

The appearance of the Zsil coal is that of an ordinary bituminous coal, its composition as determined at the Geological Institute of Vienna shows a content of 57·8 carbon 6·5 ash and 2·1 water, and its carbonic unit determined in the same way is 5582. Comparing these results with the average of a large number of good Austrian bituminous coals it shows a smaller percentage of carbon but less ash and less hygroscopic water. The carbonic unit is rather higher than the average of nine of the principal Bohemian coals of the Carboniferous period. Compared with brown coals there is less than one-seventh of the proportion of water, 25 per cent. less ash, and 30 per cent. greater heating power.

Left in the air exposed to all weathers at the mouth of the adit, in some places for three winters, the Zsil coal has remained unaltered in appearance and less injured than most bituminous coals would have been. It of course contains no pyrites.

That the Zsil coal is Tertiary is beyond a shadow of doubt. It alternates with Cerithium beds, and the few fragments of vegetation

hitherto found point in the same direction. Its exact age is not clear. After it had been accumulated and the coal had been completely formed the elevation of the highest part of the Southern Carpathian chain has tilted the beds into the basin shape. But after this again there was accumulated a large and important series of deposits, terminating with a thick gold gravel. All these beds have been uplifted and disturbed. Some even of the newer ones are much contorted, and a secondary gold gravel has been formed in some of the valleys from part of the debris of the first. Even this is not all, for the secondary gold alluvium is now forty or fifty feet above the present water level.

The Zsil coals and the rocks containing them resemble the ordinary and better known coals and coal rocks of Western Europe in many important respects, but differ from them in others hardly less important. Practically as mineral fuel they must take rank with ordinary bituminous coal, but they have no floor of underclay—no stumps or stools of trees have been observed, and fragments of leaves or twigs have not been found, or if found do not seem to indicate fern vegetation. It would probably be safe to assume that they are not ancient forests but drifted vegetable matter in an advanced state of decomposition. Still the fact of the seams of coal being very regular and easily traceable for long distances shows a considerable uniformity of action over a large area. The Cerithium bed so uniformly found over two beds of the series, but not with any others, is another remarkable fact. The ironstone bands near the thick coal are also suggestive.

It is clear from the facts determined with regard to this coal as well as from what has long been known of oolitic and liassic coals, that true bituminous coal is not limited to any geological age nor does it seem confined to any kind of rocks. Like salt it is a product of all time, and there may be deposits, equal in importance to any we know of, now in process of formation.

Nor is indefinite time necessary or sufficient to convert vegetable accumulations into true bituminous coal. Whatever the age of the Zsil coal may be it is probably not much older than the middle part of the Tertiary series; and yet other coal deposits of the Tertiaries are brown coal while this is stone coal.

Nor is any unusual exposure to high temperature essential. The Zsil coals must have been formed and disturbed before the newer beds were deposited that now occupy the valley of the Danube, but there is no volcanic disturbance whatever in the immediate vicinity, nor any indications of the coal-bearing beds having undergone more change or fracture than was necessary to bring them to their present position on the flanks of the great mountain chain. The nearly horizontal beds in the valley at the east end are good bituminous coal, differing in no respect from those that have been lifted and subjected to great pressure.

Whence then it may be asked the absence of ash and above all the absence of water in the coal? Whence the ironstone bands above and below? Why are the associated rocks hard grits and sandstones or hard shales, instead of soft marl and marly sandstones? Why is the coal of such a nature that it will bear years of exposure without

injury instead of falling at once to powder? Why are the beds continuous here and lenticular elsewhere?

These queries all bear upon the great question of the formation of coal from accumulations of vegetable matter. By widening the conditions they may at first seem only to add to the difficulties. By adding to the observations they may help some day to solve the problem.

The Lias coals of Hungary, now very largely worked, offer conditions much more resembling those here recorded than those of ordinary carboniferous coals. There also there are no underclays, and there is not much appearance of true vegetation. Some deposits are with and some without ironstone. The associated beds are generally shales more hardened than those with the brown coal, and loaded with bituminous matter, but more marly than in the Zsil. Perhaps further investigation may discover other true tertiary coals that will help to solve the difficulty. Perhaps other liassic oolitic, and cretaceous coals or even some of the carboniferous coals will throw light on the subject.

I may conclude by pointing out; Firstly, that there are two kind of bituminous coal—the one formed by the vegetation once growing on the spot, and the other by vegetable matter that has been transported by water; Secondly, that the extreme thickness of coal grown *in situ* is rarely so considerable as that which has been drifted, but is often more uniform; Thirdly, that at present, as far as I am aware, no coal *in situ* has been described with its underclay or ancient soil, except in the beds of the carboniferous period; Fourthly, that the coals most remarkable for gas and generally those best adapted for other purposes than mere fuel are of the kind not *in situ*. It should be added that in regard to heating power, percentage of ash, and hygroscopic water there is no difference to be traced, each kind varying greatly in all these respects in different localities. There is a marked and essential difference between all bituminous coals however poor and bad and the very best and purest lignite or brown coal. When therefore we find a true bituminous coal, like that of the Zsil, occupying a place in the geological series hitherto only occupied by lignites, the fact is important and significant, and calculated to throw light on the causes which produce coal from vegetable matter. At the same time the existence of a bituminous coal of the tertiary period is far too new and interesting a fact to be passed by without special remark.

The Iron Manufacture of South Wales.

(*Rails.*)

By MM. Gruner and Lan.

(Abstracted from the *Annales des Mines*, 5th series, vol. xx, p. 515.)

(*Continued from page* 14.)

The Making of the Pig-Iron.

I. *Forms, Arrangement and Working of the Welsh Blast-Furnaces.*—Wales produces specially white forge-pig, for rails and common bars, which is almost always but slightly carburetted, with a granular or cavernous appearance. But besides this make, which may be considered its normal product, some works furnish superior-quality grey pig for foundry and special irons; these are—Pontypool, Blaenavon, Beaufort, Gladys, Yniscedwin, &c., with which are connected, now and then, one or two blast furnaces of the large works of Dowlais, Ebbwvale, Cyfarthfa, &c., making pig for their use. Still the total of this class of iron does not exceed annually from 60 to 70,000 tons, or from 7 to 8 per cent. of the whole production.

Such opposite products are necessarily obtained under very different conditions. For grey pig of good quality, clean fuel and coal-measure ores are used as much as possible; but little or no red ores are added, forge cinders are entirely excluded, and the working is always with coke and often with cold air: the advantages of hot air being gained at the expense of tenacity. Thus at Beaufort, where the air is heated, weak black pig is produced, as in Scotland, instead of tough bright grey metal. For white forge-pig the charge consists of from 30 to 40 per cent. of rich, moderately reductible ores (principally the silicious red ores), and from 20 to 25 per cent. of forge cinders. Besides, the furnaces are worked with hot air and raw coal, or at least at all events with a mixture of raw coal and coke, so as to utilise the caking smalls.

The blast-furnaces used for making grey pig have a very distinct hearth (see *Mining and Smelting Magazine*, Vol. I, Plate III, Figs. 5 and 6), and the descent of the charges is slow—that is to say, the interior capacity of the furnaces ranges, as in Scotland, from 9 to 10½ cubic yards per ton of pig-iron produced in the 24 hours; and moreover for the same weight of metal there is a proportionately greater consumption of blast and limestone—that is to say, 270,000 cubic feet of air, and from 18 cwts. to 22 cwts. of limestone. White pig on the contrary is produced in furnaces without hearths, properly so called, but with high boshes—or at least with the lower sections a little less than those of Scotland, although still very large (Plate III, Fig. 10 and 14). The descent of the charges is always rapid, the interior capacity not exceeding from 6½ to 8 cubic yards per ton of pig produced in the 24 hours: the proportion of blast is reduced to from 175,500 to 216,000 cubic feet and that of the limestone from 14 to 16 cwts.

We shall here dispense with any details as to the forms and

dimensions of these blast-furnaces. We may state, however, that besides the differences just mentioned and which have reference specially to the nature of the metal, the Welsh blast-furnaces are also distinguished from those of the north of England by their moderate height, which rarely exceeds from 43 to 47 feet; and when the combustible is friable, as in the anthracite district of Swansea, it is even always below 40 feet. Thus the height of the furnaces does not depend, as was formerly thought, upon the density of the fuel or on that of the blast, but rather upon the friability of the coal and the consistency of the ores. The transverse dimensions of the upper part of the Welsh furnaces are on the contrary almost always very large: the bodies from 13 to 20 feet, and the throats from 8 to 11 feet. It is the progressive increase of the size of the body during the last thirty years which has enabled the volume of blast to be doubled, or even more (and consequently the productions of the furnaces), without modifying in anything the rate of descent of the charges.

As to the accessory apparatus of the furnaces, we shall likewise say little. The utilisation of the furnace gases dates, in South Wales, from the year 1845, and is as yet only applied to about half the furnaces; for fear of the unequal reduction of the ore. We have noticed as being very useful in this case the cone-shaped casting, which acts at once as a distributer and a stopper—adopted in certain Welsh furnaces, especially those belonging to the Ebbwvale company (Plate III, Fig. 11). Indeed this plan is not only efficacious for collecting the gases, but also as preventing "scaffolding" (obstructions to the descent of the charge), provided always that the throats are not too large. We have equally recognised the evils of the hot air apparatus generally employed in the Welsh works, and the inconveniences of twyers placed at various levels and especially those in the middle of the tymp (Ebbwvale and Abersychan). This excessive multiplication of twyers results, as in Scotland, from the too great section given to the hearth.

It seems useless to revert in detail to the special working of the furnaces, the modes of charging, the management of the blast, &c. We know that common forge-pig is obtained by keeping up a very cold working, in attaining which the success is only too great, owing to the enormous proportion of cinders used. On an average this is 20 per cent., but often, as may be seen by the example of Dowlais works, it reaches 25, 30 and even 40 per cent. In some exceptional cases even the cinders are smelted alone or almost alone. The pig-metal thus produced is necessarily so much less carburetted and more phosphoretted, in proportion as the melting zone is charged with cinders. When the proportion exceeds 25 per cent. the metal is always granular or cavernous, and the corresponding slags entirely black; according as the cinders are diminished, the metal assumes by degrees a crystalline structure, at first fibrous, next largely lamellar, with a tendency to pass to mottled. It is this mixture of lamellar and mottled pig which is sought, for the manufacture of ordinary merchant bars, or of rails above the average quality, as at Cyfarthfa, near Merthyr-Tydvil. Thus in entirely suppressing the

cinders the normal product is grey; and we have shown that in this case, owing to the low price of the fuel and the dearness of the ores, it becomes the strong interest of the Welsh ironmakers carefully to avoid a cold working. It may be mentioned here that besides the few exceptional furnaees of South Wales, already often referred to, those of the Forest of Dean produce also in general good grey forge-pig. It is disposed of either in the district itself or to the Welsh tin-plate works.

The fuel used in Wales for smelting the iron ore is coke, raw-coal, and anthracite. To the east, in Monmouthshire, where the coals are caking, the use of coke is predominant, and will no doubt become more so from day to day, for independently of its relative purity in respect of sulphur, it has also the advantage of utilising the small coal, which is of such little value. Thus at the Ebbwvale, Victoria, Sirhowy, and Tredegar, the working is generally carried on with a half or two-thirds coke even in producing pig-metal of inferior quality; and in all cases for superior products, the charge is exclusively coke, made, at least partly, of coal in lumps. (Pontypool, Blaenavon, Cyfarthfa, &c.)

Towards the centre of the district, in Glamorganshire, where the coal is less bituminous, it is most usually employed raw, as at Dowlais. Some few beds furnish small caking coal.

Westward, in the Swansea district, the coals are entirely non-bituminous. The Ystalyfera and Yniscedwin works are situated here, where for 20 years pig iron has been produced with anthracite. Still even in this district, coke is partially used. At Ystalyfera the greater number of the furnaces we saw in blast were fed with a mixture of coke and anthracite, the coke being procured from some workings many miles to the east. The use of anthracite calls for no special remark, except that the furnaces are not so high, the density of the blast is greater, and this is always very highly heated. The unconsumed small sometimes accumulates in the hearth; the readier to meet this evil three twyers have been installed in each of the embrasures at Ystalyfera and Yniscedwin, the middle one being 6 or 8 inches higher than the two others, and specially arranged so as to work in case of difficulty. The action of blast-furnaces with anthracite varies like that of ordinary furnaces, and is distinguished by the same characteristics. At Yniscedwin and at certain of the furnaces of Ystalyfera the object is to produce grey or mottled pig for foundry, and the manufacture of special irons, by smelting coal-measure ores alone, or with a small addition of red ores (30 per cent. at the maximum). The other furnaces at Ystalyfera are fed, in addition, with forge cinders and produce ordinary white pig for rails. The tunnel-head gases of the anthracite furnaces are utilised for heating the boilers and the blast, as in the case of coke furnaces. At Yniscedwin, as at Ebbwvale, they employ the distributing and stopping cone already referred to, which throws the charge towards the lining of the body of the furnace. The non-bituminous small of the central district, and of the environs of Swansea, is not, and cannot, be directly employed in the blast-furnaces. But it may be converted into coke by mixing it with some more bituminous small, or with

pitch, according to Mr. Blackwell's method. Better still, it may be agglomerated in the form of bricks as patent fuel.

The slags of the Welsh blast-furnaces, producing pig-metal for rails, are black, dense and rich in iron. Nothing denotes the presence of manganese. But we quickly recognise it by the olive yellow shade, so characteristic of the sulphide of manganese, as soon as the charge of cinders becomes nil or trifling, the action hot, and the pig-metal grey or mottled: the colour in question may be specially observed at Blaenavon, Pontypool, Yniscedwin, &c. We cannot repeat often enough that it is owing to this manganese that the English coal-measure ores furnish good products, notwithstanding their high percentage of sulphur and phosphorus.

II. *General Results.*—1. *Consumption and Production of the Welsh Blast-Furnaces.*—It has been seen by the historical résumé* that South Wales includes 200 blast furnaces, of which 175 may be working simultaneously, with an average production of 20 tons per day, or 7,000 tons per autumn.† This will make for the 175 furnaces a possible maximum of 1,225,000 tons. But in reality notwithstanding the contrary assertion of Mr. Truran, Wales seems never to have exceeded a million; indeed, for the last three years, the number of furnaces in blast has been under 150, and the total production scarcely 900,000 tons, which may be distributed as follows:—

Inferior pig for rails, 75 to 80 per cent., or	700,000
Ordinary pig for merchant bars, 15 per cent.	135,000
Superior pig for foundry or special irons, 7 to 8 per cent. ..	65,000
Total	900,000

To these quantities may be added the 20 to 25,000 tons of good quality grey forge-pig of the Forest of Dean.

The minimum production of furnaces producing metal for rails is 20 tons per 24 hours: a large number give 25 or 30 tons, and the large furnace of Dowlais 45 or even 50 tons. These quantities are approximately proportionate to the total capacity, for in all these works the furnaces have a capacity of between $6\frac{1}{2}$ and $7\frac{1}{2}$ cubic yards per ton of pig.

The pressure of the blast oscillates between $4\frac{3}{4}$ and $6\frac{1}{4}$ inches: the temperature between 300° and 330°.‡ The volume of air absolutely consumed, taken at the ordinary temperature, is on an average from 15 to 19 cubic feet per minute and per cubic yard of the total capacity of the furnaces; or from 175,500 to 216,000 cubic feet per ton of white pig.

To produce a ton of this pig there is consumed from 2 tons 8 cwts. to 2 tons 15 cwt. of ores and cinders, the burden being generally composed of:

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* See *Mining and Smelting Magazine*, vol. iii, No. 13, p. 2.

† Twenty tons is the average of all the furnaces producing grey and white pig. But in considering those which produce pig for rails with hot air, by themselves, 20 tons is a minimum.

‡ 572° and 626° Fahrenheit.

Calcined coal measure ores (Welsh mines)	40 to 50
Imported ores (principally red ores)	40 „ 25
Forge cinders	20 „ 25
Total	100

to which is added as a flux, 30 to 35 of limestone. It must always be remembered that for very inferior metal the proportion of cinders is sometimes as much as from 30 to 40 per cent.

The fuel consumed varies within wide limits, even for almost identical metal; which is caused by the nature of the coal itself and the varying proportions of coke and raw coal used. The consumption is besides always expressed in coal, and not by the weight of coke. When the charge exclusively consists of non-bituminous coal and rich fusible ores, of from 40 to 50 per cent. produce, sometimes only from 1 ton 10 cwt. to 1 ton 15 cwt. of raw fuel is consumed for the smelting of a ton of pig; but more frequently, and especially when the working is with a mixture of coal and coke, the consumption reaches from 1 ton 18 cwt. to 2 tons. In both cases there must be added for heating the boilers and the blast, from 4 to 5 cwts. of coal, where the tunnel-head gases are utilised, and from 7 to 10 cwts. where this is not the case. When the calcined ores mixed with cinders only yield from 38 to 40 per cent., and when the coal is bituminous, there is consumed as much as 2 tons 4 cwts. and sometimes from 2 tons 7 cwts. to 2 tons 8 cwts. These latter figures relate to the Tredegar and Ebbwvale works. They are explained by the small percentage of the ores, the large proportion of coke ($\frac{2}{3}$ for $\frac{1}{3}$ of coal), and the relatively low carbonisation of the coals of this part of the basin.* The consumption descends to 2 tons in the Sirhowy works, where the charge is half raw coal, and caustic lime, is substituted for limestone. The nature of the coal influences also the total weight of materials smelted. At Dowlais, where non-bituminous coal is used, 1 ton smelts 1 ton 14 cwts. of ore and limestone; at Ebbwvale, and Tredegar, for the reasons we have mentioned, from 1 ton 8 cwts. to 1 ton 10 cwts. at the most; at Sirhowy it reaches upwards of 1 ton 11 cwts., owing to the caustic lime used for fluxing.

From this white pig (for rails) we pass to superior grey pig: we shall recur again to the intermediate varieties. The Welsh grey pig-metal is of two sorts and derived from the two opposite points of the district: westward, near Swansea, from anthracite and hot air, and eastward, in the neighbourhood of Newport, from coke and cold air, as at Blaenavon and Pontypool.†

The first are obtained with from 2 tons 7 cwts. to 2 tons 8 cwts. of ores, two-thirds of which at least are calcined carbonates, and a third at most the rich hematites of Lancashire. The weight of anthracite consumed is 1 ton 10 cwts. This quantity is small when compared with the consumption in the make of white pig; but there is really nothing exceptional in it, for we should compare, not the

* They contain from 30 to 35 per cent. of volatile matters.

† Good grey pig-metal is also made with cold air, at Gladys, in the Taffe Vale, situated in the centre of the district.

raw fuel, but the relative proportion of fixed carbon: we then find that per ton of granular or fibrous white pig only from 1 ton 3 cwts. to 1 ton 4 cwts. of carbon, properly so called, is consumed, while for grey pig with anthracite 1½ ton is used: this is the usual proportion, *cæteris paribus*, between the weight of fuel consumed for white and grey pig-metal. In the Staffordshire works 1 ton 10 cwts. of fixed carbon is similarly consumed (under the form of a very long-flamed coal) per ton of grey pig. In Scotland, with identical coal, much less is used (only from 1 ton 2 cwts. to 1 ton 5 cwts.), and that for quite black metal; but the ores yield from 55 to 60 per cent., instead of from 40 to 42. The influence of a high proportion of fixed carbon is equally manifested in the weight of the materials reduced to fluid matter. In the works where anthracite is used it is upwards of 1 ton 16 cwts., while in Staffordshire it is scarcely 18 cwts., and in Scotland from 1 ton to 1 ton 4 cwts. per ton of raw fuel.

The coke and cold air pig-metal of Pontypool and Blaenavon is made with from 2 tons 14 cwts. to 2 tons 16 cwts. of ore, of which from 85 to 90 per cent. are calcined coal-measure carbonates, with at most 15 per cent. of foreign ores. The weight of limestone varies from 18 cwts. to 1 ton 4 cwts. a high figure, due to the large proportion of argillaceous ores and to the not less considerable weight of fuel consumed, of which it is necessary to flux the earths. At Blaenavon 1 ton 19 cwts. of coke, or 3 ton 1 cwt. of coal, is consumed to produce a ton of pig. But on an average this is low, for at Pontypool there is used from 2 tons 3 cwts. to 2 tons 10 cwts. of coke made from 3 tons 10 cwts. to 4 tons of coal. In the latter case there is consequently 2 tons of fixed carbon against 1 ton 15 cwts. at Blaenavon. Thus in these two works the consumption is large compared with that of Staffordshire (1 ton 10 cwts.), and in this we see very clearly the influence of hot air, to which we shall presently refer. Thus if we compare the total weight of the materials smelted per ton of coal, we find at Blaenavon 1 ton 4 cwts. and 1 ton at Pontypool: a high figure compared with the results shown by the works with hot air of Staffordshire. We thus recognise, as in the anthracite district, the influence of the richly carbonated ores of Wales.

The pig-metal for rails is not specially classified, or distinguished by numbers. And in fact it is not necessary, since it is not sold. In each establishment they merely put aside those which are lamellar, granular, and cavernous; but they almost universally class them according to the proportion of forge cinders charged in the blast-furnaces—which cinders we know have a predominating influence on the quality of the product.

The grey pigs on the contrary are generally classed into six numbers. Now in order to understand the working of a furnace it is necessary to know the relative proportion of the yield of these numbers. The following are a few examples on this point. At Yniscedwin on a weekly production of 350 tons (from 5 blast furnaces), 300 tons are sold as forge-pig to the tin-plate makers: they thus lay themselves out to produce specially, and in equal proportions, numbers 3 and 4, of a bright clear grey and of compact

texture. They avoid the darker numbers 1 and 2, the disposing of which as foundry-pig is rather difficult. At Ystalfyera they similarly apply themselves to produce metal for tin-plates, that is numbers 3 and 4, and even number 5 which is mottled. At Blaenavon, where they work more for foundry-pig,* the products of 4 furnaces with cold air during the year 1859 have been classed thus:—

Foundry-Pig:—		
No. 1	3,180	7,555
„ 2	1,451	
„ 3	2,924	
Forge-Pig:—		
Grey forge No. 4	3,228	8,915
Common forge No. 5	1,774	
Inferior forge „ 6	3,913	
Total		16,470 tons.

At Pontypool they divide them into 8 classes, and they endeavour specially to obtain average numbers, the hardness of which is greater than that of the superior numbers of a deeper grey. On a weekly production of 256 tons, in May, 1860, they obtained:—

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* The cold air pig of Blaenavon is held in high estimation on account of its tenacity. According to an official report inserted in No. 497 of the Blue-books, the pig-metal of this establishment holds a foremost place among English pig-iron. Three samples analysed at the School of Mines, Jermyn-street, gave the following results:—

Carbon	2·64	2·82	3·40
Silicium	1·68	0·81	1·36
Manganese	0·66	0·53	0·28
Phosphorus	0·27	0·38	0·29
Sulphur	0·08	0·06	0·07

The coal-measure ores smelted at these works contain from ·50 to 1·17 per cent. of manganese, sometimes as much as 1 per cent. of phosphoric acid, but generally very little iron pyrites. It seems then that some thousandths of phosphorus do not sensibly affect the tenacity of the metal. The most important point is the absence of sulphur and the small proportion of silicium. The pig-metal of Pontypool, having a less tenacity, contains according to the same Blue-book:—

Carbon	2·12
Silicium	1·46
Manganese	0·42
Phosphorus	0·32
Sulphur	0·12

That is to say, the same elements as the Blaenavon metal excepting an almost double proportion of sulphur. If we compare these figures with the analyses of Scotch pig (see *Mining and Smelting Magazine*, vol. ii, p. 206) we see clearly that the slight tenacity of the latter is, as we have said, certainly due to the large proportion of silicium, and very probably also to a higher contents of earthy metals not estimated in these analyses.

		Tons.	
No. 1	..	32	Sold as foundry-pig, properly so called.
„ 2	..	5	
„ 3	..	77	Principally used for the manufacture of ship guns.
„ 4	..	39½	
„ 5	..	71	Principally employed for fine wire and tin-plates.
„ 6	..	9	
Mottled „ 7	..	13	Accidental products: indifferent forge-pig.
White „ 8	..	9½	
Total	..	256	

If now from the largely consuming superior grey pig-metal we turn again to the ordinary white pig of the district, we should first mention the grey pig-metal of Pontypool, Beaufort, &c., made with hot air and coke. The example of Pontypool particularly, enables us to estimate the influence of hot air upon the consumption of materials.

In August, 1858:

The three blast-furnaces with cold air consumed per ton of pig:—

Coke	2·137	
Calcined coal-measure ores.	1·810	2·162
Red Hematite	·352	
Limestone	1·186	
Coal for blast	·342	

And produced in four weeks 762 tons of pig, or 254 tons per furnace; of which a dozen were white pig.

The blast-furnaces with hot air consumed per ton of pig:—

Coke	1·500	
Calcined coal-measure ores.	1·195	1·923
Red Hematite	·312	
Oolitic ores	·106	
Forge cinders	·310	
Limestone	1·033	
Coal for blast	·325	

And produced in four weeks 512 tons of pig, half of which was white.

Thus here we have with hot air a working twice as rapid, and a consumption of 1 ton 10 cwts. instead of 2 tons 7½ cwts: an economy of ·637 tons upon 2·137 tons: or of 30 per cent. But evidently these results are not comparable, since neither the ores nor the pig-metal are identical.

In May, 1860, the results were less dissimilar:—

Thus the three blast-furnaces with cold air consumed:—

Coke	2·52	
Calcined coal-measure ores ..	2·34	2·79
Lydney ores	·45	
Limestone	1·20	
Coal for blast	·22	

And produced per week the 256 tons of pig the classes of which we gave in the last page:

or per furnace 85 tons.

The blast furnaces with hot air consumed:—

Coke	1·87	
Calcined coal-measure ores ..	1·44	2·37
Lydney ores	·40	
Spathic ores of Somerset ..	·53	
Limestone	·67	
Coal for blast and hot air ..	·40	

And produced per week 118 tons classed thus:

No. 4	..	7½ tons
„ 5	..	88 „
„ 8	..	22½ „
Total	..	118 tons.

We see by these figures that if the rate of working with cold air be represented by 2, with hot air it will be represented by 3.

Besides, the consumption is reduced from 2·52 tons to 1·87 tons or a saving of 65 tons on 2·52 tons, or of 26 per cent.—an economy which would be reduced to about 20 per cent. if the products were quite similar. We thus find here figures little differing from those derived from the experience of the continental works; and this result confirms also what we have said of the effects of hot air in the Scotch establishments. We may add that at Pontypool as elsewhere, the hot air pig-metal is duller and less tenacious than that made with cold air.

To conclude, it will be seen from the preceding that if the consumption for good *cold air* grey pig be from 2 tons to 2 tons 10 cwts. of coke or from 3 to 4 tons of bituminous coal (with from 30 to 35 per cent. of volatile matters), the ordinary *hot air* grey pig only requires from 1 ton 10 cwts. to 1 ton 18 cwts. of coke or from 2 tons 10 cwts. to 3 tons of coal when bituminous, or 2 tons 14 cwts. when non-bituminous, as in the central district of Merthyr Tydvil. When the forge-pig, like that of Cyfarthfa, is white lamellar, the consumption on an average with hot air is 2 tons 10 cwts. when working with coke, and only from 2 tons 4 cwts. to 2 tons 6 cwts when the charge contains a notable proportion of raw coals. In the case of the white granular pig, it is produced in the central district with from 1 ton 18 cwts. to 2 tons of semi-bituminous coal. Thus we see that in Wales, according to the nature of the ores, the fuel and the products, the consumption may vary in the proportion of from 1 to 2 (from 2 tons to 4 tons) or even from 1 ton 15 cwts. to 4 tons, if we include the furnaces fed with anthracite.

2. *Cost Price of the Pig Iron in South Wales.*—As the consumption of coal varies in the proportion of 1 to 2, and as the charges of ore may contain from nil to 40 per cent. of forge cinders, the cost-price of the pig must necessarily differ considerably in the Principality in various works, and even in neighbouring blast-furnaces. Nevertheless these differences disappear in a great measure when we confine our observations to similar qualities of pig. Thus the cost-price of pig for rails nowhere exceeded, in June, 1860 (the period of our visit), the limits of from 2*l.* 10*s.* to 3*l.* per ton of 22 cwts., not including interest of capital: the lower estimate applying to the granular white pig, and the higher to the lamellar white pig. Except when the charge contains more than 25 per cent. of forge cinders, in which case the metal is of extremely inferior quality and not fit to be puddled alone, the cost of the pig cannot at present be lower than 2*l.* 10*s.* per ton, long weight, or 2*l.* 6*s.* 8*d.* per ton of 20 cwts. The metal from an excess of cinders is the only one that can be made for from 2*l.* 5*s.* 6*d.* to 2*l.* 6*s.* 6*d.*; but we must repeat, this metal is only fit for inferior (American) rails, and even then when puddled it must be mixed with others less charged with hurtful matters. Mr. Truran, indeed, gives for 1843 a cost-price of 1*l.* 16*s.* 3½*d.* per ton of 22 cwts; but, as we have already remarked with regard to this period, the rate of labour, and consequently the price of the coal and ores, was exceptionally low. At that time the selling price of bar iron, at the port of Liverpool, was only 4*l.* 12*s.* per ton, a price to which it had never before fallen, and which it has only touched once since (in 1852). Under present circumstances such

a reduction could not take place: all the works would be closed and ruined. We may therefore consider 2*l.* 6*s.* per ton of 22 cwts. as a minimum limit, extremely difficult, if not impossible, to pass.

Under existing circumstances the following are the elements composing the cost-price of granular white pig for rails, in taking the average charge of the Dowlais blast-furnaces, which do not differ much from that of most other works:—

	Tons	Cwt		*s.*	*d.*	£	*s.*	*d.*
Coal-measure ores, raw 1 ton 10 cwt. (or calcined)	1	2	at	10	0	0	15	0
Red Hematites of Lancashire (33 per cent. of the charge)	0	16	„	20	0	0	16	0
Cinders (21 per cent. of the charge)	0	10	„	2	0	0	1	0
Total charge	2	8		—		1	12	0
Limestone	0	14	„	1	10	0	1	3½
Coal for furnaces (partly as coke)	2	0	„	4	0	0	8	0
Coal for calcining, hot blast and boilers (partly smalls)	0	5	„	2	6	0	0	7½
Labour at furnaces in calcining and coking	—			—		0	6	0
General charges (excluding interest of capital)	—			—		0	2	1
Cost-price per ton of 22 cwt. of granular white pig						£2	10	0

But, as we have said, this is a minimum which can only be increased by a charge of from 25 to 40 per cent. of forge cinders. Indeed the labour charges sometimes reach 7*s.* or 8*s.*; the general charges from 3*s.* to 5*s.*; and the cost of the coal (which is given above at 4*s.*) is sometimes 4*s.* 6*d.* or 5*s.* But when the proportion of coke amounts to ½ or ⅔ of the charge of the fuel, the consumption is rarely below from 2 tons 4 cwts. to 2 tons 5 cwts.; in which case the cost price will necessarily approach from 2*l.* 12*s.* to 2*l.* 15*s.*: figures which we have practically met with in several of the Welsh works. Where, as at Cyfarthfa, the work is exclusively with coke, and the pig is more lamellar than granular, it may even reach 2*l.* 18*s.* or 3*l.*

If, beyond this, it is desired to make pig-metal, not only lamellar or slightly mottled, but also very free from phosphorus and sulphur, the cost-price would be still greater, for it would be necessary to reduce the proportion of cinders to about 10 per cent., and to use but little raw coal. Per ton made, the ores will then cost 34*s.* or 35*s.* instead of 32*s.*, and the consumption of coal will approach 2 tons 8 cwts. At the same time the production will be less, and consequently the labour and general charges higher. We thus arrive at a cost-price of from 3*l.* to 3*l.* 5*s.* per ton of 22 cwts.

Lastly, the superior grey pig-metal is necessarily made at a considerably greater cost, since no cinders or raw coal are used, and the working is generally with cold air, requiring a consumption of 3 or 4 tons of coal. The production is likewise less in this case so that the labour or general charges are proportionately raised. The cost-price then reaches from 4*l.* to 4*l.* 5*s.* per 22 cwts., as is shown by the following detailed account of the cost of an extremely superior cold air grey pig.:—

	Tons	Cwt.	s.	d.	£	s.	d.
Coal-measure ore raw 2 tons 16 cwts., calcined	2	2	at 12	4½	1	14	8
Foreign ores	0	11	„ 17	0	0	9	4
Total charge in ores ..	2	13		—	2	4	0
Limestone	1	2	„ 2	0	0	2	2
Coal for coke and calcining	4	9	„ 4	8	1	0	9
Coal for machines	0	4½	„ 4	8	0	1	0
Labour		—		—	0	11	2
General charges (not including interest) ..		—		—	0	6	1
Cost-price per 22 cwts.					£4	5	2

Between this superior cold air grey metal and white forge metal there comes in, as we have said, the hot air grey metal smelted with anthracite (Beaufort, Yniscedwin, Ystalyfera, Dean Forest, &c.). Its cost-price varies between 3*l.* 5*s.* and 3*l.* 10*s.* per ton of 22 cwts.

3. *Outlets and Market Conditions of Welsh Pig-Iron.*—The ordinary forge-pig is scarcely ever considered in Wales as a merchantable product. With the blast-furnaces are associated puddling and refinery forges where each maker treats his own products. The sale of the pig is entirely exceptional, and its commercial value purely nominal. The quality of the pig-metal is too variable, too easily altered by a greater or less charge of cinders (without the exterior characteristics being notably effected) for such products to become an object for a regular market. The absence of all commercial transactions prevents, in its turn, the accumulation of considerable stocks of pig; so that in several respects Wales and Scotland have absolutely nothing in common. In the South there is an intimate connection between the blast-furnace and the forge: in the North there is a complete independence of the two industries, and an immense market for foundry-pig.

The only products of the Welsh blast-furnaces which are really an object of commerce are the ordinary cold air grey pig-metals, and the superior cold air pig-metals. They are sold specially to the makers of tin-plates which are very numerous in the Principality. The exportation proper may be said to be nil:—

In 1857 it amounted to	17,642 tons.
But in 1858 it did not even reach	2,000 „

This pig principally went to the north of Europe, and is sold f. o. b. at Newport, Cardiff or Swansea; the carriage and shipping charges amounting, according to the situation of the works, to 2*s.* or 3*s.* The terms of payment are four months, or 2½ per cent. discount.

The following particulars taken during the last months of 1859 show the market prices of the various descriptions of Welsh pig f. o. b.:—

1. *Refinery pig.*	£	s.	d.		£	s.	d.
Granular white pig for rails [1]	2	12	6	to	2	15	0
Lamellar white pig for superior rails or common bars .	3	0	0	„	3	5	0
Hot air grey pig for tin-plates from the Forest of Dean and the anthracite district [2]	3	10	0	„	3	12	6
Cold air grey pig from Pontypool and Blaenavon for tin-plates and Armstrong guns [3]	4	10	0	„	5	0	0

2. *Foundry pig.*	£	s.	d.		£	s.	d.
Hot air grey pig of Beaufort, &c.	3	10	0	to	3	12	0
Pig from the anthracite district (1)	3	15	0	„		—	
Cold air pig from Gladys near Aberdare	4	12	6	„	4	15	0
Cold air pig from Pontypool and Blaenavon:—							
The inferior numbers (2)	5	5	0	„	5	10	0
The superior numbers (3)	5	15	0	„	6	0	0

(1) Scarcely ever sold and not quoted in price currents.
(2) The lower price corresponds to the mottled pig No. 5; the higher to the bright grey pig Nos. 3 and 4.
(3) The lower price for mottled pig; the higher for bright grey pig.
(4) Nos. 1 and 2.
(5) Nos. 3 and 4 of Pontypool and Nos. 2 and 3 of Blaenavon.
(6) Nos. 1 and 2 of Pontypool and No. 1 of Blaenavon.

To these details of the prices of 1859 we add the following, which show the price of *superior* forge pig (f. o. b.) for the last 25 years. These are the *mean* prices; the first marks of Pontypool and Blaenavon being quoted from 10*s.* to 15*s.* *higher;* and the less esteemed marks of Dean Forest and the anthracite districts 10*s.* *lower.*

	£	s.
1835.		
September.	5	0
1836.		
January ..	6	0
March ..	8	0
June ..	8	0
September.	7	10
December .	6	10
1837.		
March ..	6	10
June ..	5	0
September.	6	0
December .	6	5
1838.		
March ..	6	0
June ..	6	0
September.	5	15
December .	5	15
1839.		
March ..	6	10
June ..	6	0
September.	6	0
December .	5	10
1840.		
March ..	5	0
June ..	4	5
September.	4	10
December .	4	5
1841.		
March ..	4	5
June ..	5	0
September..	4	5
December ..	4	0
1842.		
March ..	4	15
June ..	3	15
September..	3	10
December ..	3	15
1843.		
March ..	3	10
June ..	3	5
September..	3	15
December ..	3	5
1844.		
March ..	3	5
June ..	3	10
September..	3	15
December ..	3	15
1845.		
December ..	5	10
1846.		
March ..	5	0
June ..	4	10
September..	5	5
December ..	5	0
1847.		
March ..	5	0
June ..	5	0
September..	5	0
December ..	4	10
1848.		
March ..	4	5
June ..	3	15
September..	3	15
December ..	4	0
1849.		
March ..	4	0
June ..	4	0
September..	3	15
December ..	3	15
1850.		
March ..	3	5
June ..	3	5
September..	3	0
December ..	3	0
1851.		
March ..	3	7½
June ..	3	10
September..	3	0
December ..	3	0
1852.		
March ..	2	15
June ..	3	0
September..	3	10
December ..	4	10
1853.		
March ..	4	0
June ..	4	10
September..	4	10
December ..	4	10
1854.		
March ..	4	10
June ..	5	5
September.	4	15
December .	5	10
1855.		
March ..	5	0
June ..	5	0
September.	6	0
December .	5	0
1856.		
March ..	4	15
June ..	4	15
September.	4	15
December .	4	15
1857.		
March ..	4	10
June ..	4	10
September.	4	10
December .	4	0
1858.		
March ..	4	0
June ..	4	0
September.	4	0
December .	4	0
1859.		
March ..	4	0
June ..	4	0
September.	4	0
December .	4	0
1860.		
March ..	4	0
June ..	3	10
September.	3	10
December .	3	10

In comparing the selling price with the cost-price we see that if the period of from 1853 to 1857 was flourishing, the profits of the

iron masters have been reduced to a minimum since 1858, even to nil during the course of the year 1860. Consequently since the year 1858 the production of Wales has been gradually diminishing. The minimum cost-price of pig-metal for rails (with 21 per cent. of cinders) is, as we have shown, 2*l.* 6*s.* 8*d.* per ton at the works, or 2*l.* 9*s.* 8*d.* f. o. b. Now the corresponding selling price (at the end of 1859) was from 2*l.* 12*s.* 6*d.* to 2*l.* 15*s.*, from which we must again deduct 2½ per cent. discount, so that there remains at the most a profit of 3*s.* to cover the interest of capital! In 1860 pig-metal for rails suffered a fresh fall of about 4*s.* to 5*s.*, which would show an absolute loss of from 1*s.* to 1*s.* 6*d.*, unless all the dead works were stopped at the collieries and iron mines.

It must be remembered however that the pig-iron for rails is never sold, so to speak, and that the prices given above are consequently purely nominal. Still it is evident that for the last three years, the Welsh iron masters have been losers, rather than gainers, by the making of pig-iron proper. We shall see further on if, at present prices, they are more fortunate in the manufacture of the pig into rails and bars.

The Condurrow District.

THE run of country which we shall call the Condurrow district, is situated in the parish of Camborne, to the south of the great mining range of Dolcoath, in the elevated granite land at the base of which the last-named mines are situated. The granite here is the western continuation of the detached Carn Brea boss: in Camborne parish it reaches its highest point in Carn Entral (585 feet above the sea level), west of which the ground gradually slopes, and the granite narrows out towards Pendarves House, where the latter ends. The killas valley, which lies between this detached boss and the main range of Wendron and Crowan, running up from the east by Wheal Buller, Wheal Basset, North Basset, South Frances, West Basset, West Frances, and the Grenvilles, forms the southern boundary of the run.

Dolcoath sett stretches some way into the granite, where it is succeeded by Wheal Harriett. This is followed on the south by Condurrow, which again south is adjoined by South Condurrow, extending to the middle of the killas valley. Wheal Harriett and Condurrow are adjoined on the West by Wheal Tryphena; and South Condurrow by Tolcarne. These five setts may be said to constitute the Condurrow district.

CONDURROW is a mine of considerable standing, although of course comparatively modern as compared with the great old mines to the north. The lode was originally cut in an adit level (coming up from Pendarves), 46 fathoms deep from surface, where it presented a fine appearance, and above which, such good profits were made, that immense expectations were entertained of the sett, which it was anticipated would turn out another Dolcoath. These sanguine views, however, were never realised, for although Condurrow has

been a productive and fairly paying mine, it cannot be classed as a rich one.

The accompanying section, fig. 6, on the course of the main lode, will best show the position of the workings of this mine at present. They are all in the bottom of the mine, at or below the 140 under adit (or 186 fathoms from surface); the drivages and sinkings in operation being the 140, 155, and 165 driving east, the 177 driving east and west, and the engine shaft sinking. The engine (Pryce's) shaft and Hope's shaft (56 fathoms apart) are those through which the stuff is drawn, there being one skip in the former and two in the latter (although only one is at present working). Woolf's shaft is 45 fathoms further east, down to the 130, and will no doubt come into play as a working shaft when the mine is more opened out in that direction. The water is very easy, the pumping-engine being only a 36″ cylinder working the following lifts:—7½″ at the 40; 7″ at the 60; 7″ at the 100; 7″ at the 130; and 7″ at the 165; which drains the mine by working about four strokes per minute. The skips are worked by wire ropes.

The 140 is driven about 20 fathoms east of Hope's shaft, and is now being extended by two men at 6*l.* 10*s.* per fathom. The lode is from 4 to 6 feet wide, yielding work worth about 1½ cwt. of tin per 100 sacks, showing a money value of 8*l.* or 10*l.* per fathom. We have said that the "lode" is from 4 to 6 feet wide, but the "leader part," which alone can be strictly considered lode, is only 10″ wide: the remainder of the lode is made up of irony capels, plentifully speckled with quartz, which flank the leader part in the north and south. These capels have no regular walls, but pass insensibly into the granite of the country; still as they are stanniferous, they are considered to be "lode" by the miners, and no doubt properly so—but they certainly are not parts of the original vein, which is here only 10″ wide. They form another characteristic instance of that metamorphosing and replacing action which, emanating from an original fissure, has altered the neighbouring rock and impregnated it with metalliferous matter for a considerable distance, the whole forming a "lode" in the mining meaning of the term.*

The 155 east of Hope's, is driving by a man and a boy at 4*l.* per fathom, on a lode from 4 to 6 feet wide, producing work worth 1 cwt. per 100, and of a money value of about 5*l.* per fathom. West of this end 5 fathoms, a winze is sinking to the 165 by four men at 4*l.* 10*s.* At the back of the 155, between Pryce's and Hope's, there is a stope working by four men at 4*l.* per fathom, on a lode 7 feet wide, yielding work worth about 1½ cwt. per 100, showing a value of 10*l.* per fathom. In the bottom of the level there is also a stope working by six men at 6*l.* per fathom, on a lode 7 feet wide, yielding work worth 2 cwts. per 100. There is a great quantity of fluor spar in this stope, and generally throughout this lode where there is a fair produce of tin. Between the two shafts, 9 fathoms west of Hope's, there is another winze sinking to the 165, by six men at 5*l.*

The 165 east of Hope's is driving by six men at 7*l.* 10*s.* per fathom, on a lode 5 feet wide, yielding work worth 4 cwts. per 100

* Compare vol ii, p. 143.

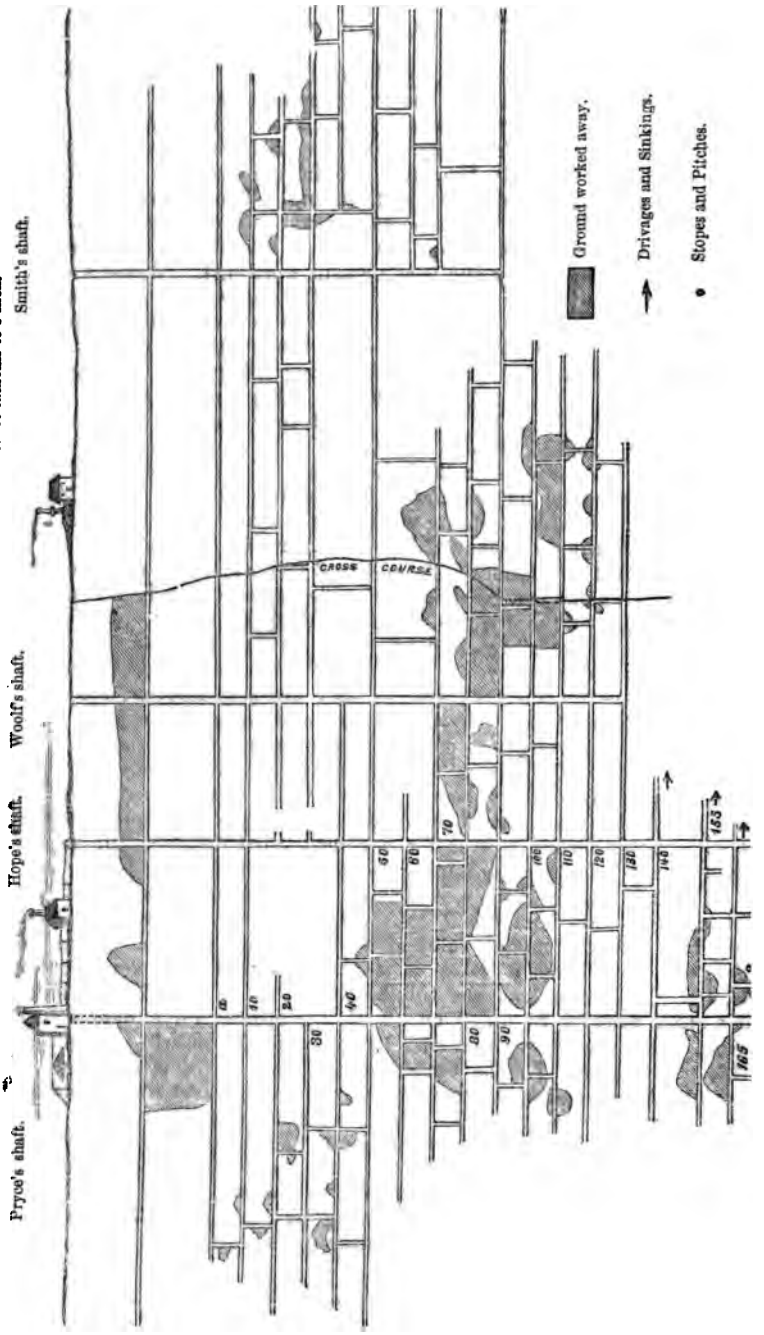


FIG. 6.—SECTION ON THE LINE OF THE CONDURROW MAIN LODE. Scale: 60 fathoms to 1 inch.

sacks, showing a money value of about 20*l.* per fathom. The lode in this end is very different from, and considerably improved, compared with those above, being well veined with quartz. In Hope's shaft, below the 165, there is a productive lode yielding work worth 4 cwts. per 100.

In the back of the 165, adjoining Pryce's shaft, the lode makes in two parts, with a horse of about 4 feet between them, all of which is tinny and will come away; the capels on the north wall also containing some tin. There is a stope now working here by two men at 4*l.* per fathom. In the bottom of the 165, about 33 fathoms east of Pryce's, there is a winze sinking (down 3 fathoms) by four men at 4*l.* per fathom. The lode in this winze is about 10 feet wide, very open, with a mass of dark decomposed matter in the middle, containing some peach and a good deal of iron: its value is not known.

The 177 east is driving by eight men at 7*l.* 10*s.* per fathom, on a lode 4 feet wide as far as seen, yielding work worth 4½ cwts. per 100, showing a money value of nearly 30*l.* per fathom. The 177 west is driving by two men at 3*l.* per fathom, on the south part of the lode (yielding low class work) worth about 8*l.* or 10*l.* per fathom. In this end, the best of the lode is supposed to be still to the north, for on cutting into this side of the level further east, some rich work was broken.

The valuable tin ground at present being taken away in Condurrow, is between the 165 and the 177, where there are four valuable stopes working, the positions of which are indicated in the section. Two of these are working under the 165, east of Pryce's, by six men each. In the east of the winze, the leader part of the lode is 5 feet wide, composed of fluor-spar, quartz, peach, and some iron; this, however, is not the most productive part of the lode, the rich tin being principally found in the north capels, which are of an elvany character. These for about 2 feet wide on the north of the lode are very rich, but the south side is poor; they afford another instance of the phenomena of metalliferous impregnated "country," so common in Cornwall. This stope (working at 6*l.* per fathom) yields work worth from 5 to 6 cwts. per 100, and its money value is about 50*l.* per fathom. The stope west of winze (also working at 6*l.* per fathom) on a lode of 9 feet wide, yielding work worth 7 cwts. per 100, has a money value of from 50*l.* to 60*l.* per fathom. To the north of this stope there is a magnificent face of almost pure crystalline black tin. These stopes are worked down 3½ fathoms below the 165, from which level to the 177, there is 11 fathoms of ground.

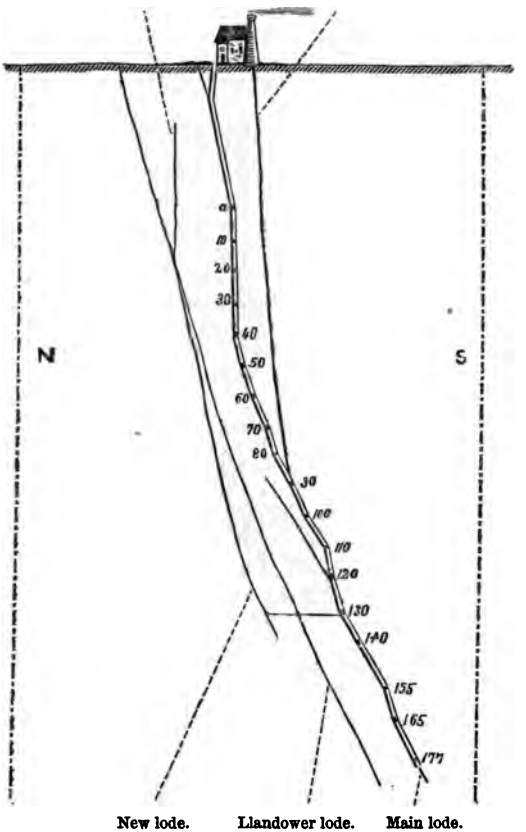
Of the two stopes working in the back of the 177, one is to the west of the eastern end, by six men at 5*l.* per fathom, on a lode 6 feet wide, yielding work worth from 6 to 7 cwts. per 100, showing a money value of 50*l.* per fathom. For the width of the working, this is the richest stope in the mine: it is worked up 12 feet. The other stope is a little to the west of Pryce's shaft, and is working by four men at 3*l.* per fathom on a lode 10 feet wide, worth from 30*l.* to 40*l.* per fathom.

The engine shaft which is now down about 5 fathoms below the 177, is sinking by twelve men, at 35*l.* per fathom (7 fathoms stint). The lode has varied a good deal here, but when we saw it, was worth about 50*l.* per fathom for the length of the shaft. The bearing of

the main lode is about W. 8° S., and its underlie south, as shown in the accompanying transverse section, fig. 7, taken across the lodes

FIG. 7.

TRANSVERSE SECTION AT PRYCE'S ENGINE SHAFT. Scale: 60 fathoms to 1 inch.



at the engine shaft. Besides the engine lode, it will be seen that there are four others marked in this section—the Llandower lode, New lode, Hick's lode, and South lode.

On the Llandower lode, which has been of considerable importance, the adit is now being extended east of Hope's, on a lode worth 2 tons of low quality copper ore (worth 40*s.* or 50*s.* per ton). At the back of this level there is also some copper ore now being raised, and also at the bottom of the 60 on the same lode.

On the New lode, the 40 is being driven east and west of Hope's: the east end is poor, but the western one is worth about 1 ton per fathom. The 50 east is also driving on this lode east of Hope's; and ore is being raised at the bottom of the 30 and the 40. On the South lode, the 60 is being driven west of Woolf's.

The length of the sett on the run of the lodes, is about 576 fathoms. South it extends 80 fathoms from the adit, which is a restricted limit considering that the lode underlies in this direction: the total width of the sett is about 140 fathoms.

The mine is now returning about 260 tons of copper per two months, and 35 tons of tin. The average produce of the work from which the latter is produced may be taken at $2\frac{3}{4}$ cwts. per 100. Besides the pumping engine, there are two whims (21″ each), one of which crushes and draws at the engine shaft. The eastern whim will soon draw 2 skips at Hope's.

It will be seen from what has been said, that the bottom levels have greatly improved as to the quality of the tin-stuff compared with those above, where the produce of the work was very low. This shows that there is a fair prospect of Condurrow making a permanent tin mine. It is now under the pursership and Management of Mr. Reginald Grylls, of Redruth, the managing agent being Captain John Moyle, formerly at United Mines. Until recently, Condurrow had been for many years under the management of Captain Nicholas Vivian, the elder brother of Captain Joseph Vivian of North Roskear.

The hands employed here at present are: Tutwork-men 126; Tributers, 27; Trammers, &c., 16; Engine men, 9; Smiths, 5; Dressing pare, 160; Carpenters, &c., 6; and Surface labourers, 4.

At Tryphena mine nothing is doing at the present moment. After lying abandoned for some years, it was last year again put to work by Captain Richard Pryor, as Tryphena Pendarves, but the adventure soon came to an end, without any efficient trial being made. The engine and materials on the ground have recently been bought by Messrs. Francis Pryor and Richard Michell, who intend, it is said, to rework the sett again. Considering its position on the run of the Wheal Harriett and Condurrow lodes, it certainly seems worthy of a vigorous and miner-like trial.

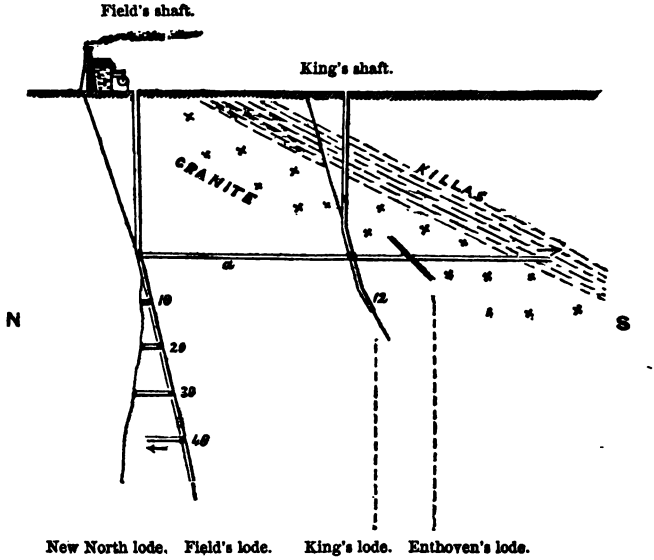
South Condurrow, although hitherto barren of results, seems a sett of great promise. Many fine lodes, the continuation of those of West Basset and other mines eastward, have been opened on by the deep adit level; and in the eastern part of the sett an engine has been erected, and the mine explored some way below adit. Although hitherto unsuccessful, this piece of ground cannot be considered to have had, as yet, anything like an adequate trial. The numerous lodes afford an immense scope for explorations, and it will certainly be a matter of surprise if, with an efficient system of working, they do not yield some good result.

Tolcarne mine is at present working in a prudent and miner-like manner, under the management of Messrs. John Taylor and Sons, and Captain Joseph Jewell, of South Tolgus. On a former occasion it was worked as West Grenville, but then it was under the influence of a share-market management—so that there was considerably more share-selling than mining: the lode then wrought is not now in working, the present operations being much further north, on parallel lodes. Of those there are three principal ones now in course of working, Field's lode, King's lode, and the New lode, as shown in the accompanying transverse section, fig. 8. The junction

of the granite with the killas is also shown: the killas is that forming in the valley between the two granite ranges.

FIG. 8.

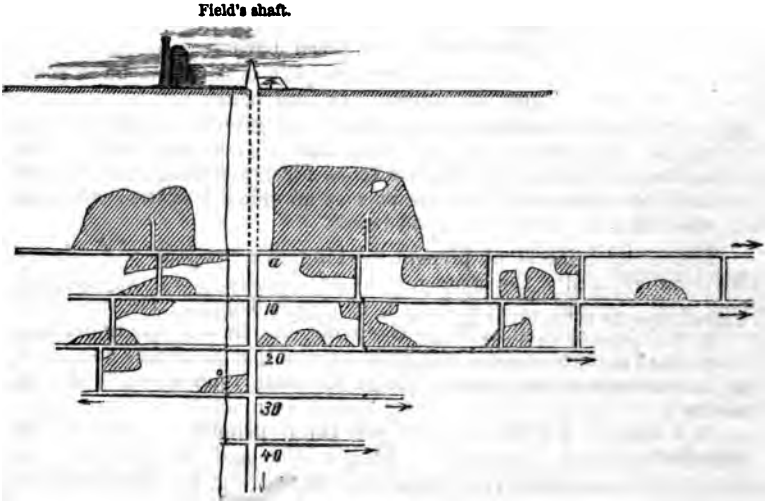
TRANSVERSE SECTION AT TOLCARNE MINE. Scale: 40 fathoms to ½ inch.



The main workings are on Field's lode, where the shaft is down 9 fathoms below the 40, and is now sinking. The accompanying section, fig. 9, shows the workings on this lode. The only level

FIG. 9.

SECTION ON LINE OF FIELD'S LODE, TOLCARNE. Scale: 40 fathoms to 1 inch.



driving west is the 30, but the adit, 10, 20, 30, and 40 are driving east, and some of these are opening out orey ground. At the adit this was a most promising lode, making a fair quantity of ore, and a splendid gossan: this seems to dip east, and judging from the lode in the levels driving, and the country, there would seem to be every chance of success here.

The New North lode falls off, downright at the adit from Field's, from which it has been cross-cut to at the 10, 20, and 30, with a cross-cut also driving at the 40. On this lode the 20 and 30 are both driving east and west, the 30 west being worth $1\frac{1}{2}$ tons per fathom. This is a very pretty and promising lode.

King's lode has been explored to 12 fathoms below adit, at which level the ends are driving east and west, being now extended about 8 fathoms each. This is also a very promising lode.

The other lode marked in the section—Enthoven's tin lode—has been a very curious discovery. It was met with in extending the adit south, and really seems to be something in the nature of a *carbona*. The tin made on north and south branches for about 4 fathoms under the adit, where it died away, the bottom being now poor; the formation has been driven on west, but every vestige of lode or joint soon died away. Yet this discovery—so thoroughly accidental—has yielded 617 tons 16 cwts. 2 qrs. of tin stuff, which was sold to the buyers at an average price of 4*l.* 5*s.* $4\frac{3}{4}$*d.* per ton, giving a total of 2,637*l.* 19*s.* $7\frac{1}{2}$*d.*

The whole of the work at Tolcarne, pumping and winding, is performed by a small 18″ double engine. The pit work is 6″, a pole being fixed at the 30 at Field's. The adit at this mine is a branch from the Tryphena adit, the same that goes into Condurrow. From Enthoven's lode it is now being driven south in the killas, towards the old mine, to which there is at present about 85 fathoms to drive. About 12 fathoms south of the present end, Tippett's lode is expected to be cut.

Abstracts and Reviews.

THE *REVUE UNIVERSELLE.*

Revue Universelle des Mines de la Métallurgie, des Travaux Publics, des Sciences et des Arts, appliqués à l'Industrie, sous la direction de M. Ch. de Cuyper, Professeur Ordinaire à la Faculté des Sciences de l'Université de Liége. Sixth year, 5th livraison, September and October, 1862. Paris and Liége, E. Noblet, à Paris, rue Jacob, No. 20.

The contents of this number of the *Revue Universelle* are of more than usual interest. They are:—

1. Sur la théorie des machines à vapeur et particulièrement des machines à enveloppe de vapeur, par E. Bède, Professeur à l'Université de Liège.
2. Des trépans de forage, par W. Von Leckendoff, Directeur de Salines.
3. Note sur la fabrication des fontes d'hématite dans le North Lancashire et le Cumberland (Angleterre), par M. S. Jordan, ingénieur. Which we abstract.
4. Notes sur la fabrication de l'acier en Angleterre, par Ed. Grateau, ingénieur.

5. Exposition Universelle de Londres, 1862. Partie méchanique, par M. V. Dwelshauvers, ingénieur mécanicien.

6. Waggon de mines et culbuteur de Gréasque (charbonnages des Bouches du Rhône), par P. E. Biver, ingénieur civil.

7. Revue des Sociétés savantes de France et de l'Industrie Françaises, par A. Boucard, ingénieur civil.

BULLETIN.—Note sur la concentration de l'acide sulphurique à 66° dans les appareils en verre, par F. Delmarmol, ingénieur civil.—De l'utilisation des produits zincifères par voie humide, par M. C.—Sur les avantages et désavantages mécaniques et économiques de la condensation par surface.—Note sur la dosage de l'argent, par F. Field.—Purification du gaz, présence du sulphure de carbone.—Recherches sur le fontes et le puddlage.—Réactif sensible de l'acide sulfhydrique.

M. Bède's article, On the theory of the Steam Engine, although not completed in the present number, is evidently one of considerable importance, as it calls in question the accuracy of the theories hitherto generally received. As we shall probably have occasion to discuss M. Bède's article at length on its completion we shall not dwell upon it on the present occasion.

M. von Seckendorff's paper On Boring Tools is one of the best we have seen for some time on the subject, which is one of great practical importance, and worthy of more attention than it generally receives. The various forms of tools are discussed, and their desiderata plainly shown. Altogether the paper is well worthy of the attention of those interested in the subject.—M. Jordan's very interesting paper On the Iron Works of North Lancashire we abstract elsewhere.

The paper of M. Grateau, On the making of Steel in England, is a memoir which does the greatest credit to the author, and is fairly entitled to take its place beside the elaborate labours of MM. Gruner and Lan. Following M. Le Play who, twenty years ago, gave a valuable memoir, in the *Annales des Mines*, of the making of Steel in England. M. Grateau has founded his paper on a series of observations made during a journey in England in 1860. He originally proposed to make these observations the subject of a more extended memoir; but being prevented from carrying out this idea, he decided upon publishing them in the form here given of simple notes. They included a summary of an extensive set of observations made in a large number of works in London, Birmingham, Newcastle, Middlebro', Sheffield, and Liverpool. In making these observations the author remarks that, in the matter of steel, he found much more reserve among makers in giving information than among the iron-masters. He attributes this to a fear, on the part of the former, for the monopoly they still enjoy—due in his opinion to the exceptional circumstance of having acquired a great perfection by a long course of practice. This perfection he thinks, however, is now being attained on the Continent; where science being called in to aid practice, he believes they will shortly be in a position to struggle successfully against the system of "blind routine" followed in Yorkshire. We shall have occasion at a future time to return to this paper.

M. Dwelshauvers' paper On the Mechanical Department of the International Exhibition, of which the first part only is given in this number, seems a capital review; and it is besides profusely illustrated.

The other contents of the number—all excellent in their way—call for no special notice.

ARUNDELL ON THE LAW OF MINES.

A Practical Treatise on the Law relating to Mines and Mining Companies. By Whitton Arundell, Attorney-at-Law. London: Lockwood & Co., Stationers' Hall Court.

A popular, and yet sound, exposition of the law of mines and mining partnerships is evidently a desideratum. We do not think we are unjust to the existing literature on the subject when we say that it is either too purely technical for the general reader or too slight and flimsy to be of any value. What we want is something on the model of Lord St. Leonard's *Handy Book of Property Law*—intelligible to a layman, and yet perfectly sound as far as it goes. Mr. Arundell's little book is of this kind, and will, we think, be found of great use, It treats, in ten chapters, of the Nature and Transfer of the Property of Mines; of Mining Partnerships; of the Rights connected with the working of Mines, and of Rights of Water and Ways; of Criminal Offences connected with Mining; of the Rating of Mines; and of the Stannaries Court. In appendices are given forms of licenses, agreements for leases, and leases, and the three Acts relating to Stannaries Court *in extenso*. It is altogether a book we can recommend to those interested in mining property.

THE BOARD OF TRADE RETURNS.

The "Accounts relating to Trade and Navigation of the United Kingdom, for the month ended 30th November, 1862, and eleven months ended 30th November, 1862," have been issued by the Statistical Department, Board of Trade.

IMPORTS.—The quantities and relative increase and decrease of the imports of metals, metallic ores, and mineral products, for the month and eleven months ended 30th November, have been as follows:—

	Month ended 30th November.			Eleven months ended 30th November.		
	1861.	1862.	Increase (+) or Decrease (−)	1861.	1862.	Increase (+) or Decrease (−).
Brimstone ... ... cwt.	45,517	84,421	+ 38,904	770,404	985,794	+215,390
Copper Ore ... ... tons	2,483	5,955	+ 3,472	65,422	72,514	+ 7,092
Copper Regulus ... ... „	1,870	1,000	− 870	18,134	29,821	+ 11,687
Copper, unwrought and part wrought ... cwt.	37,260	27,360	− 9,900	263,020	243,840	− 19,180
Iron, in Bars, unwrought tons	3,472	5,970	+ 2,498	31,423	39,152	+ 7,729
Steel, unwrought ... „	322	260	− 62	3,239	3,796	+ 557
Lead, Pig, and Sheet ... „	1,392	2,232	+ 840	17,227	19,937	+ 2,710
Spelter or Zinc ... ... „	2,350	2,934	+ 584	19,171	17,630	− 1,541
Tin, in Blocks, Ingots, Bars, or Slabs ... cwt.	7,515	5,103	− 2,412	52,379	67,562	+ 15,183
Silver Ore ... ... value in £	48,300	3,808	− 44,492	259,278	273,646	+ 14,368
Quicksilver ... ... lbs	22,014	223,625	+201,611	1,845,353	1,057,074	−788,279

EXPORTS.—The quantities, declared value, and relative increase and decrease of the exports of metals, minerals, and metallurgical articles of British and Irish produce and manufactures, for the month and eleven months ended 30th November, have been as follows:—

	QUANTITIES.				DECLARED VALUE.					
	Month ended 30th November.		Eleven Months ended 30th November.		Month ended 30th November.			Eleven Months ended 30th of November.		
	1861.	1862.	1861.	1862.	1861.	1862.	Increase (+) or Decrease (−)	1861.	1862.	Increase (+) or Decrease (−)
					£	£	£	£	£	£
Alkali: Soda ... ...cwt.	140,635	136,065	1,278,687	1,901,763	53,743	56,193	+ 2,450	547,656	803,962	+ 256,306
Coal, Cinders, and Culm ... ...tons	539,971	565,142	7,377,833	7,699,763	238,974	264,862	+ 25,888	3,666,604	3,462,783	− 203,821
Iron, Pig and Puddled ... ... „	28,785	31,351	365,202	416,667	77,906	88,385	+ 10,479	986,344	1,126,886	+ 140,542
Iron, Bar, Angle, Bolt, and Rod... „	18,971	26,775	234,904	278,130	140,962	203,272	+ 62,310	1,715,588	2,043,422	+ 327,834
Railroad Iron, of all sorts ... „	17,820	29,702	359,223	372,906	134,062	214,950	+ 80,888	2,762,122	2,594,792	− 167,330
Iron Wire ... ... „	660	1,644	10,878	12,346	13,170	31,945	+ 18,775	193,594	264,288	+ 70,694
Iron, Cast ... ... „	6,060	7,101	69,351	59,169	56,755	59,148	+ 2,393	642,182	514,995	− 127,187
Iron Hoops, Sheets, and Boiler Plates ... ... „	5,919	9,254	76,721	95,301	59,001	91,766	+ 32,765	779,571	936,330	+ 156,759
Iron, wrought, of all sorts ... „	9,103	12,559	99,336	124,012	181,546	219,383	+ 37,837	1,868,752	2,070,445	+ 201,693
Iron Steel, unwrought ... ... „	1,705	1,567	19,858	22,819	59,132	55,325	− 3,807	656,531	744,249	+ 87,718
Copper, unwrought, in Ingots, Cakes, or Slabs ... ... cwt.	4,320	7,555	81,181	95,809	21,597	37,450	+ 15,853	404,679	468,311	+ 63,632
Copper, wrought or partly wrought, Bars, Rods, Bottoms, Pans, Plates, Sheets, and Nails; and mixed or Yellow Metal for Sheathing .. „	19,246	33,852	270,771	384,213	94,302	163,238	+ 68,936	1,296,692	1,800,854	+ 504,162
Copper, wrought, of other sorts... „	2,011	765	43,324	24,069	12,979	5,130	− 7,849	248,804	145,628	− 103,176
Brass of all sorts ... ... „	2,658	3,679	27,499	34,923	15,129	19,461	+ 4,332	152,671	189,448	+ 36,777
Lead, Pig, Rolled, Sheet, Piping, Tubing, and Lead Shot tons	1,843	2,950	18,125	32,768	39,284	62,682	+ 23,398	398,913	693,596	+ 294,683
Lead, Ore, Lead, Red and White, and Litharge of Lead ... „	395	355	5,315	7,099	9,704	8,618	− 1,086	135,386	161,412	+ 26,026
Tin, unwrought ... ...cwt.	4,146	3,694	53,309	75,351	24,565	21,384	− 3,181	323,523	436,209	+ 112,686
Tin Plates ... ... „	—	61,028	—	942,920	81,575	76,314	− 5,261	817,821	1,138,769	+ 320,948
Zinc or Spelter, wrought or unwrought ... ... „	4,941	11,253	82,458	89,090	5,415	11,660	+ 6,245	89,680	90,464	+ 784
Salt ... ...tons	45,110	60,959	666,245	629,569	21,799	28,695	+ 6,896	352,098	302,839	− 49,259
					1,341,600	1,719,811	+ 378,211	18,039,211	19,989,682	+ 1,950,471

JORDAN'S MODELS ILLUSTRATIVE OF CRYSTALLOGRAPHY.

Nets for the Construction of Models, Illustrative of the Simple Forms of Crystallography; with Explanatory Remarks. By James B. Jordan, Museum of Practical Geology. London: Edward Stanford, Charing Cross.

Without making any pretensions to originality, Mr. Jordan offers, in these "nets," a useful contribution to the study of mineralogical science. We have not the least wish to exaggerate the importance—in an economic sense—of an accurate knowledge of mineralogy, but no one can deny its great utility under various circumstances; and without an acquaintance with crystallography the ready recognition of mineral species is always uncertain. Plane projections give a very inadequate notion of the real forms of crystals, and elaborate models are beyond the reach of the general run of students.

The Explanatory Remarks, which are founded on Mr. Warington Smyth's Mineralogical lectures at the Royal School of Mines, are clearly expressed and excellently printed. The formulæ given are those of Naumann, the same as are used in Nicol's *Manual of Mineralogy*. Altogether we can recommend these "nets" to practical students of mineralogy.

NOTE ON THE CONCENTRATION OF SULPHURIC ACID TO 66 DEGREES IN GLASS VESSELS.

In the last number of the *Revue Universelle*, M. Ferdinand del Marmol, suggests the following modification in the application of glass vessels, to concentrating sulphuric acid to 66°.

The acid as it comes from the leaden chambers varies from 45° to 50°. It may, beyond this, be concentrated to 60° in leaden apparatus; but its concentration to 66° has only been practically effected in platina or glass vessels. Platina has the advantage of great durability, economy in labour and fuel, of yielding a large production, and involving no loss of acid. Its disadvantage is the great capital required, which precludes its use in localities where there is only a moderate consumption of highly concentrated acid.

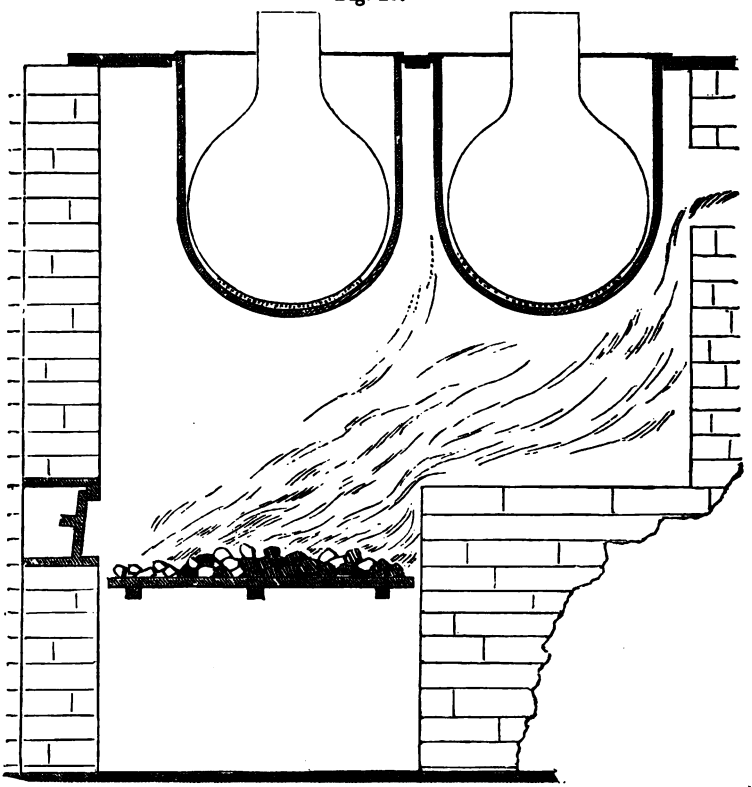
The apparatus in glass is constructed as shown in Fig. 10, which is drawn on a scale of $\frac{1}{15}$th. In the cast iron top are inserted four cast iron pots, each 20″ high and 18″ in diameter, in which are placed, in a sand bath, glass vessels 21″ high and 14″ in diameter; the neck of each vessel being connected by a leaden (or better still a glass) pipe, which carries the acid vapour to a leaden chamber for condensation. Each vessel is charged daily with 56 lbs. of acid at 60°, from which, on an average 82 per cent. of acid at 66° is returned.

This apparatus has the advantage of requiring only a small capital, but it has been attended with great inconvenience from the frequent breakage of the vessels. M. del Marmol has successfully met this difficulty by a modification, which consists in merely enlarging the necks of the vessels from 2″ or 2½″ to 4½″ or 5″. An experience of two years of vessels worked on this principle, shows that the principal cause of breakage has been entirely removed.

The conditions attending the breakage of the vessels are well known. When the acid is heated to a certain degree it suddenly bursts out, breaking its vessels, and falling on the neighbouring ones which it breaks likewise. Since the alteration in the neck this is not found to occur, although the fire has often been purposely pushed. We can readily conceive how an enlargement of the neck diminishes any sudden pressure caused by the

generation of the vapour, and obviates this bursting out of the acid. Besides this cause of breakage there are certainly some others remaining—such as a sudden cooling of the vessels, flaws in the glass, &c.; but as these can be obviated by care, they are not of special importance.

Fig. 10.



It is thus possible, by this modification, to avoid the evils hitherto connected with the use of glass vessels in concentrating sulphuric acid, arising from breakages; and their dangerous consequence in burnings by the acid, and nuisance to the neighbourhood, in the sudden discharge of large quantities on the occasions of considerable breakages.

NOTE ON THE MANUFACTURE OF HEMATITE PIG-IRON IN NORTH LANCASHIRE AND CUMBERLAND.

By M. S. Jordan.

Ingénieur de la Société des gaz et hauts-fourneaux de Marseille.

(Abstracted from the *Revue Universelle.*)

As is well understood in France, the aim of the greater number of the English iron-masters has been to make as largely and as economically as possible, without caring very particularly for the quality of the products.

To this end the works were established on the various coal-fields, using the ores of the basins. Such works produce iron at a very low price, but often of very indifferent quality—as several French purchasers have discovered since the opening of the Treaty of Commerce. The very superior iron required in England—such as for the making of steel—has been imported from Sweden and Germany.

This state of things however is now being changed. The masters of the blast-furnaces of Wales, Staffordshire, &c., are learning to improve the quality of their metal by the mixture of imported ores, particularly the red ores of Whitehaven and Ulverstone. Nor does improvement stop here. The International Exhibition has shown that several large works in England are seriously undertaking the manufacture of special pig-irons of superior quality, and that in this they have already attained remarkable results, both as to the character of the products and the cost of make. The old doctrine—almost sacred in England—that the ore should always be brought to the fuel, and not the fuel to the ore, is being abandoned. This doctrine also long reigned sovereign in France, and the few exceptional works (such as the blast-furnaces at Marseilles) were quite recently considered as chimerical enterprises. But in both countries these routine and traditional dogmas are now disappearing.

Every visitor to the International Exhibition must have remarked in the Eastern Annexe, the magnificent model of the Ulverstone works, which, contrary to every principle held a few years ago, is situated at a considerable distance from the coal-basin which supplies it with coke. The special fitness of the red hematites of North Lancashire and Cumberland to produce iron of a peculiar character, fit for the making of steel, taken together with the establishment of such important works, has created an interest in the subject which has induced us to compile this notice—more particularly as this district has been passed over by MM. Gruner and Lan, and its importance dates only a year or two back.

Having reached Ulverstone by rail, the stranger is surprised to find that near this little town are the only blast-furnaces in England working with wood: the Newland works, situated near the sea, and those of Backbarrow, at the southern point of Lake Windermere, both belonging to Messrs. Harrison, Ainslie & Co. These furnaces are worked with the ore of the neighbourhood, and charcoal made from the woods of the county: their products are sent to Yorkshire. For many years they have been the only survivors of the three or four similar ones which existed at the beginning of the century. Messrs. Harrison, Ainslie & Co., are the only representatives of the old metallurgy: they have two other furnaces not at present in blast, one at Duddon, in Cumberland, and the other at Bunawe, in Argyleshire.

The offices of the Ulverstone Hematite Ironworks of Messrs. Schneider and Hannay are also at this town, although the furnaces themselves are at some distance, and are reached by the railway to Furness Abbey, whence a branch line turns off to the port of Barrow; situated at the extremity of the promontory of Low Furness. Here the works are situated where with six furnaces only, 10,000 tons per month of pig-iron are already made with the ores of the district and coke from Durham. Barrow as a port has already acquired some consequence from the quantities of hematite ore shipped to South Wales, but from the projects on foot, it promises to become a place of considerably greater importance.

The Egremont mines, and the mines and iron works of Cleator Moor are in the neighbourhood of Whitehaven, on the borders of the well-known coal-basin, with which port they are connected by branch railways. The Cleator Moor works, where there are now five blast-furnaces working with coke, is a very old establishment, but has only recently attained its present importance. The grey hematite pig-metal of these works was the first

English iron from which Mr. Bessemer obtained satisfactory results, and he still prefers it for his process.

Continuing north from Whitehaven we soon reach the port of Workington, where there are important collieries and iron-works. The Workington iron-works have now six furnaces; like Cleator, their importance, recently insignificant, is daily increasing, and both would certainly have a still greater development if it were not for the limited character of the coal-basin. Thus all the iron-works of North Lancashire and Cumberland are in the neighbourhood of the sea, bordering the Lake district.

Ores.—Fuel.—Pig-Metal.—Means of Communication.

Ores.—The iron ores of North Lancashire and Cumberland belong to the class of red hematites, but their exterior characteristics are not always identical. In certain mines the ore has the appearance of the *lithoide* hematites of Lavoulte and of Privas, while at others it is hard and lustrous like the *agathisé* ores of the same district. At times it forms as a *kidney ore*, with a fibrous and radiated fracture and an almost metallic lustre, in which case its produce reaches 67 or 68 per cent. There is also an unctuous powdery variety (*puddling ore*) used by the makers of malleable iron, and also by puddlers for the soles of their furnaces. Lastly it takes a dark earthy form (*black ore*) which contains a considerable proportion of manganese.

The gangue of all these ores is essentially silicious, the proportion of lime being small. There are traces of sulphur, phosphorus, with sometimes lime and arsenic; and almost all contain a certain portion of manganese. One of the finest specimens of the radiated ores exhibited at the International Exhibition gave :—

Peroxide of iron..	98·26
Silica	1·59
Phosphate of iron	·30

with traces of lime and manganese, showing a produce of 68·78 per cent. of iron.

The following are some of the analyses of *red ores* made under the direction of Dr. Percy at the Royal School of mines. The samples were selected to some extent, but still the general mean percentage of the ores of the district often approaches 60 per cent., and rarely falls below 55 per cent.

	Hard Ore of Cleator Moor.	Soft Ore of Cleator Moor.	Lindale Moor Mine.	Gillbrow Mine.
	Per cent.	Per cent.	Per cent.	Per cent.
Peroxide of iron	95·16	90·36	94·27	86·50
Protoxide of iron	—	0·19	—	—
Protoxide of Manganese ..	0·24	0·10	0·23	0·21
Lime	0·07	0·71	0·05	2·77
Magnesia	—	0·06	—	1·46
Alumina	0·06	1·43	0·63	0·38
Silica	5·66	7·05	4·90	6·18
Phosphoric acid	tr.	tr.	tr.	tr.
Sulphuric acid	tr.	tr.	0·09	0·11
Bi-sulphide of iron	tr.	0·06	—	—
Carbonic acid	—	—	—	2·96
	101·19	99·96	100·17	100·57
Percentage of metallic iron ..	66·6	63·3	66·	60·5

As to the Geological position of these hematite ores it is much the same in Cumberland and North Lancashire—the ores occurring in both places in the Carboniferous Limestone and the Millstone Grit, not far from the schists on which these formations rest. The principal workings are at Cleator, Egremont, Parkside, Lindale, Mousell, Roanhead, Stainton, Elliscales, and Rickithills. At the Park mines, belonging to Messrs. Schneider and Hannay, there is in course of working a bed of rich ore, 500 feet in extent every way, the thickness of which has not yet been ascertained.

In 1857 about 320,000 tons of ore were raised in Cumberland of which 50,000 tons only were consumed locally; and 500,000 tons in Lancashire, all exported but 20,000 tons. The production continues rapidly increasing, for in 1860 the 22 mines of Cumberland, including the ores exported from Whitehaven, and what was consumed in the works of Cleator and Workington, yielded 473,853 tons of a mean produce of 66·6 per cent., valued at 11*s.* 6*d.* per ton on the mines. The production of the 22 mines of North Lancashire, in the Ulverstone district, including the consumption of the Ulverstone and Barrow works, and the exportation of the two ports, amounted in the same year to 528,641 tons, of a mean produce of 65·98 per cent., valued at 10*s.* 9*d.* per ton on the mine.

Fuel.—As we have said the two Cumberland works of Cleator and Workington use coke made from the coal of the Whitehaven basin. The production of this basin for the four years ending 1860 was as follows :—

1857	956,148 tons.	1859	1,057,517 tons.
1858	933,938 „	1860	1,188,617 „

The Ulverstone works are not supplied from the Cumberland basin. The cokes they use are made at Messrs. J. Pease & Co.'s works at Darlington in Durham, so well known for the superior quality of their coke. They do not contain more than 5 or 6 per cent. of ashes, and their price, at the kilns is about 9*s.* per ton. They are brought from 90 to 100 miles by rail to the Barrow works, where they cost about 18*s.* per ton. If we judge by the model exhibited at the International, Messrs. Schneider and Hannay intend ultimately to make their own coke, for the plan shows a large range of coke ovens.—As to Messrs. Harrison, Ainslie and Co's furnaces, they are supplied with charcoal derived from the woods of the hills of the Lake district.

Pig-metal.—The following are the statistics of the make of pig-iron at the commencement of the second half-year of 1862, in Lancashire and Cumberland :—

Name of Works.	Proprietors.	Furnaces.		
		Total.	In Blast.	Out of Blast.
LANCASHIRE.				
Kirkless Hall ..	Kirkless Hall Co.	4	3	1
Backbarrow ..	Harrison, Ainslie & Co. ..	1	1	0
Newland	Ditto	1	1	0
Barrow	Schneider and Hannay ..	7	6	1 (new)
CUMBERLAND.				
Cleator Moor	Whitehaven Hematite Iron Company	5	4	1
Duddon	Harrison, Ainslie & Co. ..	1	0	1
Seaton	The Earl of Lonsdale ..	1	0	1
Harrington ..	Edwin Lewis	1	0	1
Workington ..	Workington Iron Co. ..	6	4	2
West Cumberland ..	West Cumberland Hematite Iron Company	4 (new)	0	4

The production of hematite pig-iron in the two counties has been:—

In 1859	.. ..	76,588 tons.
1860	.. ..	169,200 „
1861	.. ..	164,542 „

The mean production per furnace in 1860 and 1861 was about 10,000 tons; but the new furnaces of Barrow exceed this average, since they produce as much as 90 tons per 24 hours. All the works ordinarily produce a medium grained grey metal, so well known under the name of *hematite pig-iron*, and which appears to have special aptitudes for the making of steel—particularly by the Bessemer process—for which purpose the greater portion of it goes to Yorkshire and Sheffield. This special application of hematite pig seems to find a parallel in France in the red hematite metals of Lavoulte and Privas. The selling-prices of this hematite pig-metal is best shown by the following quotations of the commencement of September, 1862:—

	£	s.	d.	
Cleator or Workington hematite No. 1	3	15	0	per ton.
„ „ „ 2	3	12	6	„
„ „ „ 3	3	11	0	„
„ „ „ 4	3	10	0	„
„ (grey: mottled grey)	3	9	0	„
„ (mottled: mottled white)	3	8	0	„
„ (white)	3	7	6	„
Barrow hematite No. 1	3	10	6	„
„ „ 2	3	10	0	„
„ (mottled and white)	3	9	0	„

The greater value of Nos. 1 and 2 of the Cleator works, compared with the same numbers from Barrow, is due to the former being more like the Scotch pig-iron in grain and carburisation. As a comparison we may point out that at the same time the ordinary foundry pig (Nos. 1, 2 and 3) was worth from 2*l.* 7*s.* 6*d.* to 2*l.* 12*s.* 6*d.*

Means of Communication.—The Lake district has long been isolated from the industrial centres of England. Beyond the local consumption, its hematites had long no outlet except the ports of Whitehaven, Barrow and Ulverstone, whence they were shipped to Wales. The railways made of late years have put the district in connection with Lancaster, Liverpool, and the North-Western system, but by this route the coals and coke of Durham and Northumberland could only reach it by coming an immense round. It is only lately that the district has been put in direct communication with the North-Eastern coal-field, by an extension of the Stockton and Darlington Railway, and the making of the South Durham and Lancashire Union Railway, which comes into the Lancaster and Carlisle line at Tebay. The erection of the extensive works of Barrow has certainly been a consequence of the making of this line, to which it already yields a traffic of upwards of 250,000 per annum in coal, coke, and pig-iron. A similar result may follow in the Whitehaven district when the branch now making from Penrith to Cockermouth is completed.

THE AMERICAN JOURNAL OF SCIENCE AND ARTS.

The American Journal of Science and Arts. Conducted by Professors B. Silliman, B. Silliman, Jun., and James D. Dana; in connection with Professor Asa Gray, of Cambridge, Professor Louis Agassiz, of Cambridge, Dr. Wolcott Gibbs, of New York. Vol. xxxiv (second series) No. 102, November, 1862. New Haven: Editors.

In the current number of this well-known scientific periodical there are several articles on matters connected with economic geology and chemistry

On the Saliferous Rocks and Salt Springs of Michigan; by Alexander Winchell, which we shall give an abstract next month.

On the Carbonates of Alumina, Glucina and the Sesquioxydes of Iron, Chromium and Uranium; by Theodore Parkman, M.D.

Researches on the Platinum Metals; by Wolcott Gibbs, M.D.

Contributions from the Sheffield Laboratory of Yale College—IV. Observations on Cæsium and Rubidium; by Oscar D. Allen, Ph. B.

On Arithmetical Relations between Chemical Equivalents; by M. Carey Lea.

On the occurrence of Triphyline at Norwich, in Massachusetts; by George J. Bush.

In Dr. Parkman's paper, many of the discordant results of former investigators of the precipitates produced by the alkaline carbonates in solutions of alumina, glucina, and the sesquioxides of iron, chromium and uranium, are accounted for; and some very important practical facts elucidated. These establish one interesting point—that none of these carbonates conform to the theory of Berzelius, that the number of atoms of acid in a neutral salt corresponds to the number of atoms of oxygen in the base; on the contrary their composition is generally the same as that of the salts of the protoxides, one atom of acid to one atom of base.

Dr. Gibbs' important paper on the Platinum metals, is continued from a former number and is not yet completed. When completed we may probably again refer to this memoir.

The object of Mr. Lea's paper—the author of which is known as a writer on this special subject—is to explain the use of negative equivalents which he has used to complete certain series. He shows, on the authority of D'Alembert and Carnot, that the general assumption that a negative quantity is less than nothing is erroneous: taken in an isolated sense they are mere mathematical abstractions, if taken in connection with the operations by which they are produced they are full of significance.

Mr. Brush's paper shows that the well-known crystallised phosphate of manganese, iron, and lithia found associated with spopumene at Norwich, whose species has hitherto been considered doubtful, is identical with triphyline.

Besides these articles special to our subject, there are several on Natural History, and two of remarkable interest by Dr. Bache, Supt. U.S. Coast Survey, on the variation of Magnetic Forces.

ON THE MINES, MINERALS, AND MINERS OF THE UNITED KINGDOM.

By Robert Hunt, F.R.S., Keeper of Mining Records, Royal School of Mines.

(Read before the Society of Arts, December 17, 1862.)

(*Continued from page* 35.)

It is interesting to examine the unmistakable Celtic manners of the south and west of England, and then those which have a more directly Teutonic origin, of the northern districts. There are differences in the habits of life of the man, but the idiosyncrasies of the miner are the same. This may be due in part to the intermixture which has taken place between the mining races. The German miners who came to England when Elizabeth was queen, settled, some in Cumberland, and some in Cornwall. Edward the Black Prince is said to have taken many hundreds of the lead miners of the northern counties to work the rich silver-lead mines of North Devon, and the Cornish miners are allowed the merit of having introduced improved machinery into the mines of Durham and Northumberland.

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Beyond the similarities which may be traced to this interchange, there are others which clearly belong to the business of mining, and which are probably as old as the days when Job said, "Surely there is a vein for the silver, and a place for the gold, where they find it. Iron is taken out of the earth, and brass is molten out of the stone."

The phsycological influences of subterranean toil form a strange but interesting subject of study. These and the effects of that continued uncertainty as to the reward which labours of the severest kind are to receive, are distinguishingly marked on every miner. In occult powers they are believers; and when, about a century since, the "Divining Rod" was introduced into Cornwall as a means for finding mineral lodes, it was eagerly seized upon, and, to the present day, several families are supposed to possess remarkable powers as diviners, or, as they are commonly called "dowsers." The most elementary laws of science are still a book sealed to the large majority of miners, and while they are, of all men, themselves the most theoretical, they always meet any attempt to explain phenomena upon the evidences of inductive research, by pronouncing the explanation to be a "theory, which is of no value to a practical."

We therefore find that the means adopted for determining the value of a mineral district, or of a metalliferous vein, are of a most uncertain character. The task is committed to men who have only their prejudices to guide them. By prejudices we must be understood to signify crude opinions formed from mere experience—and empirical knowledge of the most imperfect kind. "Without principles, one mining agent recommends a trial to be made, which another rejects as unworthy, consequently should there be funds at command, and a sufficient period of time allowed to elapse, no portions of the veins or lodes are left untried, and practically the art of mining has degenerated into a mere try-all system."

The author whom we have quoted (Wallace), himself a miner, continues: "The impossibility of arriving at any knowledge of practical value respecting ore deposits in veins, is avowed by those who, with singular inconsistency attach the greatest importance to individual experience. Even some occupying high distinction as directors or proprietors of mines affirm, without qualification, that it is impossible to see through solid rocks, or they summarily dismiss further considerations on this subject, by remarking that the old adage current among miners expresses an important truth, namely:—

It is only by cutting the ground
That the metal is found.

The Cornish miners express their doubts by a similar phrase:—

Where it is—there it is.

If these are not the apologies of indolence and ignorance, they certainly are the utterances of despair." *

It must be admitted that amongst the miners there is an entire absence of any method by which a knowledge may be obtained of the causes leading to the production of mineral deposits. While the speculations of those philosophers who will not endure the toil of subterranean investigations are wild, and consequently valueless.

The natural consequence of this imperfect knowledge is, that all mining operations are necessarily attended with much uncertainty. From time to time a most productive mine is discovered. The Devon Great Consols, first known as Huel Maria, has paid 826*l.* dividends upon every

* "The Laws which Regulate the Deposition of Lead Ore in Veins, illustrated by an Examination of the Geological Structure of the Mining District of Alston Moor." By William Wallace. London: Stanford.

share, one pound only having been paid for shares now worth 490*l.* each. Upon the shares of South Caradon, near Liskeard, the trifling sum of 25*s.* only was ever paid; the last price of those shares was 390*l.*; and 391*l.* profit has been paid on every share.

There are other examples of great success in mining. Such results as these are laid hold of by designing men, and used to bait the hooks by which those who are in a hurry to be rich are to be caught. Permission to search for minerals is obtained from the possessor of the land near to some productive mine. A few trial pits are probably made, and then comes the formation of a company to work, "Huel Chance" (or some more attractive name is adopted), through which the lodes from the fortunate neighbour are shown, by the aid of a parallel ruler, to run. Twenty thousand shares is a usual number; but we see 25,000, 30,000, and even 65,000 shares proposed in prospectuses issued to the public. These are offered at 1*l.*, at 2*l.* and at 5*l.* per share. By a very ingenious system of puffing, by "reports" obtained from practical miners, by exhibiting specimens of ore "slocking stones" not always obtained from the mine, the riches of which they are supposed to represent, and by the occasional "wireing" (the cantterm for telegraphing) great discoveries which have but little reality, large numbers of those shares are sold. From the nominal capital a deduction of from 20 to 30 per cent. must be made. The speculators on the mining market are of three classes, men with no means whatever, men possessing very little money, and men with names, who become the promoters or directors of such mines as these, for a "consideration." The mine has probably originated with men of one or other of these classes; they obtain their remuneration by exacting from the company when formed, free shares or money, and either one or the other is taken from the nominal capital with which the mine will stand charged. Transactions of this character and sundry enigmatical operations connected with buying and selling of shares, swallow up much more of the subscribed capital; everything is carried on with that easy assurance which deceives the unwary, and the audacity with which false statements are made, often throws the experienced off their guard. The works at the mine, of course go forward, and a manager is engaged who will report the wonderful prospects of the undertaking. If by accident a discovery of ore is really made, the promoters are soon enriched, and all goes "merry as a marriage bell." If no such accident favours them, they draw largely on the credulity of their dupes, and, having obtained as much money as possible from them, there is a sudden collapse of the affair.

Such is the character of a number of the mining companies which rise rapidly and perish with equal rapidity. Any system based on misrepresentation must dread the introduction of real knowledge, and consequently, all those who are concerned in such a system desire that ignorance should prevail, and they sometimes boldly persuade the miners that it is a "folly to be wise."

There is, however, a more satisfactory chapter than this in the history of British mining; and after the experience of considerably more than twenty years—with constant attention to the subject—I feel assured that mining, commenced with proper judgment, legitimately carried onward, guided by the advice of experienced miners, and directed by honest intentions, is as satisfactory a speculation as any in which a capitalist can engage. In evidence of this it is pleasing to adduce an instance of the result of undeviating honesty and ordinary caution. Upwards of fifty mining adventures were entered on; these represented a net capital of about 500,000*l.*; the mines were worked, exhausted, and abandoned. During the period between their commencement and termination these mines made a profit of upwards of 800,000*l.*

Thus we learn that, notwithstanding the uncertainty which attends all mineral explorations in the present state of our knowledge, adventurers

may, by availing themselves of the assistance of men whose judgment has been formed by a careful study of any selected locality, and whose opinions are not biased by improper influences, not merely escape loss, but actually realise a fair profit if their speculations are sufficiently extensive. By this is intended, the advice of an old and successful miner—Never to put all your capital into one mine, but to extend it over many mines.

The question, however, still naturally arises—are there any methods by which may be determined, before commencing operations and expending capital, whether there are metalliferous minerals in the vein it is proposed to explore? By stating briefly a few of the speculations which have been brought forward, it will be seen how curiously men have avoided the labour of investigation, and contented themselves with random guesses. Agricola, the earliest writer on the art of mining, had some clear views on the science of mineralogy in its widest sense. He believed the deposits in the lodes to have taken place from water, but his chemical knowledge did not enable him to understand the process. The dim light thrown by Agricola on the subject soon went out, and at the commencement of the last century fermentation was the favourite hypothesis—*la fermentation dans certains points particuliers de la montagne.* Organization, or something analogous to vegetable growth, followed upon this—*Les filons puissants en sont les branches principales; les veinules et les filets en sont les rameaux.* (Lechmann). The time at my disposal will not admit of a detailed examination, with the requisite care, of the evidences which have been brought forward to support the views promulgated from time to time by different writers on the involved problem of metalliferous deposits in veins. Amongst the older writers we find Rösler, Delius, Baumer, Gerhard, and a few others, regarding water as the agent employed by nature to fill the veins with mineral matter.

Becher, Stahl, Henkel, Von Oppel, Hutton, and Playfair suppose those veins to have been formed by the operation of subterranean heat. Hoffman, Zimmerman, and Wallerius, who write with that involved caution, which ever betrays the want of clear views, devise hypotheses which oscillate between fire and water. Amongst modern writers we find Fournet advocating the aqueous theory,* and Bishoff powerfully supporting it, with the addition of chemical forces which appear necessary to the production of the mineralogical phenomena observed. Professor Cotta, who has studied with much care the apparent relations between igneous rocks and ore-veins, assumes that the metals originated in the depths of the earth, and that, under the influence of heat, they have been sublimed, to be deposited in the colder cracks near the surface. Delesse is clearly disposed to refer eruptive rocks and mineral lodes to the same cause, and Amédée Burat follows this path.† The leaning of Deville is also in this direction. Leithart puts forward some vague ideas on electrical action. This writer's subterranean geometry is good, but his physics are sadly at fault. Becquerel records some exceedingly curious experiments, showing that electric currents will produce many of the phenomena observed in mineral deposits. Robert Were Fox has produced miniature veins in clay by the long continued action of weak voltaic currents. These experiments have been repeated by myself upon a much larger scale than those originally made by Mr. Fox, and the results have been in remarkable confirmation of that gentleman's views. All the more important writers who have dealt with this subject have now been named. Sir Henry de la Beche, who commenced the Geological Survey of the Kingdom, and established the Museum of Practical

* "Etudes sur les Depots Metalliferes," par M. J. Fournet, Paris: Levrault. 1834.

† "Traité du Gisement et de l'Exploitation des Minéraux Utiles," par M. Amedée Burat. Paris: Langlois et Leclercq.

Geology, as the ...
regarded as ...
Jory Henwood ...
mines ...
the mineral ...
on the ...
studied.

LONG-WALL ...

At the ... the summer ... F.G.S., in the ... of the Society ... a paper of ... on—Long-Wall ... First remarking ... of the greatest ... yield per acre. ... accident, I do not say ... under all circumstances ... over the pillar-and-stall ... while on the other ... advantage upon ... Perhaps the most important ... the coal may be ... other. If we take the ... system, which is certainly ... ton, it at once lessens the ... or 93,600 tons per ... paid upon the quantity sent ... lessee to the lessor: but it ... source are considerable where ... pillar-and-stall system, and ... if, as is often the case, the waste ... ruinous. If we consider this waste in a ... important to the whole community as it is to the proprietors ... for although there may be no fear of the coal of the United Kingdom ... exhausted for a couple of centuries, it cannot fail to occur that ... another century, coal will not only be far more difficult to work ... the increased depth at which it will have to be wrought, but that ... our existing coal-fields will have been worked out and many ... to very narrow limits.

The long-wall system has produced a greater percentage of round coal in every case that has come under my own observation than ... system. The most striking advantage I have seen is in the Three ... Mine at Clayton Colliery. This mine was formerly worked upon the long-wall system, but by some means it was discontinued, and for about twelve months it was worked upon a modification of the pillar and stall ... when the percentage of round coal was only twenty-eight ... months subsequent, and for six months previous, the percentage of round coal was over eighty-five. I am quite aware that differences exist in the same seam within a limited area, and that a greater percentage of round coal may be produced from different parts of the same mine with precisely the same system of working; and this circumstance renders it difficult to compare the two systems. But in the case referred to no such difference existed. In the Roger Mine, Haughton, the difference in the yield of

round coal was 4¾ per cent in favour of the long-wall system. The experiment was fairly conducted over the working of ten thousand tons of coal; but these advantages being more than counterbalanced by the difficulty experienced in keeping good the wagon-roads, the strict long-wall system was abandoned for a modification of it. The Peacock Mine, Hyde, furnished more favourable results than the Roger Mine. These are not the only mines where I have made direct experiments, but I select them because one furnishes an example most favourable to the long-wall system, as producing a greater percentage of round coal, while this advantage in the other mines may be counterbalanced by disadvantages of another kind.

The Three Quarters Mine varies from 20 inches to 2 feet in thickness, and rests upon a floor containing many nodules of ironstone, which renders it somewhat difficult to hole or undermine the coal in floor. The roof is a strong grey metal, suitable for walling or building packings with: the angle of inclination is about 20°. The Roger Mine is 4 feet in thickness, and reposes upon a coarse fire-clay. The roof is a strong metal with rock binds, but it is very irregular, sometimes being difficult to keep from falling, and at others being one of the best of roofs: the angle of inclination is about 28°. The Peacock Mine, known in the neighbourhood of Oldham by the name of Bent Mine, is about 2 feet 6 inches in thickness, and is one of the most fiery seams in the South Lancashire coal-field. It rests upon a floor composed of alternate layers of shales and thin seams of coal; and the roof is composed of tender shale for about eighteen inches in thickness, above which, a strong dark coloured metal is found. The roof of this mine perhaps contains more fossil plants than any other in the district: the angle of inclination is about 35°.

In working coal on a properly conducted system of long-wall working, where the mine is adapted for the system, there can be little doubt that the risk of accidents from falls of roof is materially lessened. In my own experience I have never had such an accident with the long-wall system. But we ought not to overlook the fact, that some mines are naturally more dangerous than others, and that the danger increases in proportion as the thickness of the seam increases, and that as a rule, it is the thinnest seams that are worked upon the long-wall system. The ventilation is far more simple in long-wall working than in pillar-and-stall; besides which, the health of the workman is not so impaired by driving narrow or strait work, which is in a great measure dispensed with. If the seam be a fiery one, and the colliery well regulated, a current of air will be conducted to the working faces by means of bratticing, but that can only be done at considerable cost and inconvenience, and must consequently be put down as an item against the pillar-and-stall system.

Another advantage for the long-wall system is of importance to those who spend most or all of their capital in sinking shafts, erecting machinery, &c. It is the advantage of being able to dispense with the large outlay consequent upon driving narrow work in a systematic manner preparatory to working back the pillars; and thus securing a return for the capital expended in the least possible time. I am aware that there are managers that do not wait for the levels or headings to be driven to the boundary before they begin to work out any coal that they may deem eligible, regardless of ulterior consequences. I have seen many instances where this want of system has prevailed, but in no case has it been attended with anything but ultimate disappointment and dissatisfaction. The North of England is the parent of the pillar-and-stall system, but is now more or less used in every coal-field in Great Britain as well as upon the Continent. It admits of an almost unlimited quantity of coal being daily worked from the same area that would only admit of a very limited output on the long-wall system. With many this is an advantage that must weigh in favour of the pillar-and-stall system; although for my own part I confess that I am not an advocate for raising very large quantities where a smaller

quantity with judicious management would produce a better profit. With the pillar-and-stall system the workings may be conducted any reasonable distance upon the line of level, the only limits being the increased cost of conveying the coal to the pit's eye, and the difficulty of thoroughly ventilating the workings owing to the increased drag or resistance that has to be met in conveying currents of air through long-air courses.

(*To be continued*).

Correspondence.

MR. CURRY'S THEORY OF VEINS.

SIR,—I beg to acknowledge the full justice you have done in giving my ideas on the formation of metalliferous veins, so far as a brief abstract would admit; but I cannot help thinking that a much more forcible impression might have been conveyed, had the paper with its illustrations been given *in extenso*. It was as much abridged as was consistent with giving a clear explanation of the causes of the varied phenomena. In your abstract, it is stated that the throws and shifts of the veins, and the bent positions of the strata in their vicinity, must, in general, necessarily decrease downwards and *vice versa*. Though the statement is correctly given, yet, lest it should convey an idea that the throws, &c., of veins must always invariably be found to decrease downwards, I would here wish to quote the following modifying sentence from the paper, in order to offer some additional elucidation on this point. "Also in agreement with the theory, veins may not always augment in their throw towards the surface, but may sometimes in an intermediate place have little, or, perhaps, no throw at all, just in conformity to the varied conditions of deposit on each side of the vein." In the case of a vein building contemporaneously with the strata, heat is being evolved along its whole line of bearing, which occasions a deposit peculiar to the vein, which is not unfrequently called vein stuff. Not only are the vein materials of deposit different in quality to those of the strata, but they are also different in structural arrangement. One particular noticeable structure is the formation of a number of nearly vertical planes, often somewhat parallel to each other. This structure is in all probability owing to the upward force of escaping heat not allowing a horizontal bedding across the vein. The vein deposit thus differing in quality and structural arrangement from that of the enclosing rock makes the vein a complete cutter or divider of the strata. This being the case, it is quite evident that if at any point of the building of the vein and strata, the sediments continue to fall in equal quantities on each side of the vein, it would manifest no throw through such a space of deposit. But though the next succeeding period of deposition, should the marine movements control the sediments so as to cause them to fall in larger quantities on one side of the vein than on the other, a throw would be the result: that side on which the greater amount of sediments had fallen being, of course, the up-thrown one. Should the marine movements take such a change, during another interval of time, as to reverse the sedimentary quantities falling on each side of the vein, then, the throw would gradually diminish till it became nothing, and, by the persistency of this state of deposition, an up-throw would necessarily be attained on that side which was deeper down the down-thrown one. Thus, at the several stages of deposition, the varying throws of veins are accounted for; and it is highly suggestive that the variation of hade, &c., admits of an explanation by a somewhat similar mode of reasoning.

Boltsburn, Eastgate, JOHN CURRY.
January 20th, 1863.

LLANFAIR MINE.

SIR,—If you refer to the sales of lead ore in your last number, you will find the Llanfair sale priced at 1,374*l.* 15*s.* 6*d.*, it should be 2,374*l.* 15*s.* 6*d.**

The sale of the plant, &c., of this mine, realized 750*l.*, making a total to the credit of this Company of 3,124*l.* 15*s.* 6*d.* Can you, or any of your readers, say what has been the appropriation of this sum, as I have received no intimation of any dividend coming to me in right of the few shares I held in the company.

Yours obdt. Servant,

London, *January* 8, 1863. VENDITUS.

Notes and Memoranda.

A NEW PIGMENT.—The Abbé Moigno describes in *Cosmos* a new pigment used in the workshops of M. Oudry, of Auteuil. Its foundation depends upon the electro-deposit of copper in an impalpable powder, which, combined with benzine, can be employed upon any surface as a paint. It possesses an agreeable lustre, and will take bronze tints by the usual chemical means. By reducing the quantity of copper, and adding bases of lead, zinc, or other metals, M. Oudry obtains a series of paints said to possess great advantages over those prepared with turpentine and ordinary oils.

ALUMINIUM AND ITS ALLOYS.—Messrs. Bell Brothers, of Newcastle, have recently produced a modification, which they term "whitened aluminium," in which the unpleasant zinc-like hue of the metal is obviated. They have also formed keys of aluminium, alloyed with two per cent. of nickel to increase its hardness. Aluminium bronze is made of three qualities, the first containing ten, the second seven and a-half, and the third five per cent. of aluminium, the residue being copper. These varieties of bronze are scarcely to be distinguished in appearance from gold; their specific gravity, however, being rather less than that of copper (8·95), differs remarkably from that of the precious metal, the specific gravity of which is 19·5. From aluminium wire and foil, the lighter weights used for chemical purposes may be advantageously made, since, occupying something like seven times the space of those of platinum, they are more easily adjusted and handled, and less likely to be lost. The finest aluminium wire advantageously serves to suspend from the beam of the balance, objects the specific gravity of which is being ascertained. MM. Collett, of Paris, have constructed a chemical balance, in which, not the beam only, but every part, down to the milled head, by which the beam is released, is made of aluminium.

ALUMINIUM BRONZE.—In the supplementary number to vol. xxiv, of the *Philosophical Magazine*, there is a remarkable article by Lieut.-Colonel A. Strange, F.R.A.S., on the properties and present value of aluminium bronze, an alloy consisting of 10 parts of aluminium and 90 of copper. Its tensile strength is stated at 73,185 lbs. per square inch, being more than double the breaking strain of gun-metal, and 1,185 lbs. more than the average tenacity of cast-steel. Its resistance to compression is 132,416 lbs. to the square inch; that of cast-iron being 115,542 lbs. As to malleability, this alloy may be drawn out under the hammer almost to a needle point at a red heat. Its rigidity is about 3 times that of gun-metal, and 44 times that of brass; it is less affected by change of temperature than either of the latter; it may be cast with extraordinary facility into any shape; its does

* This was a typographical error in the first figure.—ED.

not clog the file, and yields fine elastic shavings on the lathe. It tarnishes much less readily in the air than any other metal or alloy used for astronomical instruments, and will receive the finest graduation possible. It is extremely elastic, can be rolled into sheet metal, or also hammered and drawn, and seems admirably adapted for the tubular parts of astronomical instruments. Its specific gravity is 7·689, nearly the same as wrought-iron. To make this alloy, extremely pure copper should be used; the best is copper deposited by electricity; but, since that kind is very expensive, the next best is copper from Lake Superior, which makes an alloy of excellent quality. The ordinary coppers of commerce generally fail, owing, it is said, chiefly to the presence of iron, which appears to be specially prejudicial. Another precaution is to remelt the alloy two or three times. The first melting, in the proportions above stated, produces an alloy of extreme brittleness; but each successive melting, up to a certain point determined by the working, and particularly the forging properties of the metal, improves its tenacity and strength. The present price of English made 10 per cent. aluminium bronze is 6*s.* 6*d.* per lb., or four or five times the price of gun-metal; but as a much smaller quantity of the new alloy would give the same strength, the cost of ordinance made of it would not be very considerably increased.

Gold at Cariboo.—Marvellous accounts have been transmitted from Vancouver's Island as to the gold findings at Cariboo, which would seem to be a veritable El Dorado, or "Tom Tiddler's ground." At "Steel's Claim" the owners were picking up the grains and nuggets as fast as they could be gathered. 80,000*l.*, the cost price of a single claim of 1,000 feet, had been collected out of one-tenth of the area. In another, 20 ounces of gold were obtained in half as many minutes. Elsewhere a man obtained leave to try his luck in a spot passed over by the owners, and realised 104 ounces, and we hear of a thousand pounds-worth being taken out of a hole 3 feet wide. One man, finding that another owner had a space of 112 feet, the law allowing only 100, straightway "jumped" the 12 feet, and the law sustained him in possession. He took out 2,000*l.*, and sold his little claim for 800*l.* The man to whom he sold it, got 1,200*l.* more out of it. This careful measure has gained the title of "Twelve-foot Davis."

New Blasting Powder.—Messrs. Thomas and Emanuel propose the following composition as an improved blasting powder:—Nitrate of soda, sulphur, chlorate of potash, starch, and ground bark, or other absorbent carbonaceous material.

Coal in India.—The *Calcutta Englishman* says:—"Coal to a large extent has been found in Eastern Rewah, and the Government of the North-Western Provinces has forwarded to the Supreme Government, correspondence connected with it, and solicited provisional sanction of an expenditure of 70,000 rupees to form a road for the connection of the coal district of Singrowlee fields with Mirzapore.

Death of a Geologist.—It is with very great regret we have to record a melancholy accident, by which the Geologist of the Island of Jamaica, Mr. Lucas Barrett, lost his life. The unfortunate gentleman engaged a boat at Port Royal, for the purpose of diving in the harbour, and, on reaching the spot, adjusted the diving apparatus about his person and at once descended; but he neglected, it seems, to take the precaution of attaching a particular rope around his body, preferring he said to hold it in his hand. He had been down for about 20 minutes, when suddenly, to the horror of the boatmen, his body appeared on the surface of the water a little distance from the boat, floating as if life were extinct. With all speed they drew it into the boat, when their worst fears were confirmed, the poor gentleman being found quite dead.

Mining, Quarrying, and Metallurgical Review.

WESTERN COUNTIES.

A CAREFUL examination of the mining accounts of Cornwall and Devon for the six months ending 31st December, shows the following results. Thirty-five mines have divided profits, amounting in the aggregate to 107,350*l.*, showing an average profit, per dividend mine, of a little more than 3,000*l.* About one hundred and fifty mines have made calls, amounting in the aggregate to about 170,000*l.*, showing an average loss of a little over 1,100*l.* per mine. Besides these, there is a considerable number of mines that have divided neither profits nor losses. There thus appears to have been a loss, on Cornish and Devon mining enterprise for the half-year, of about 63,000*l.*, without making any allowance for interest of capital invested, which, taking the quoted prices of shares as a criterion, amounts to some millions. This, too, it must be understood, is the minimum loss; for while the accounts are nearly complete as to the dividends paid, they are very far from being so as to the calls or enforced payments, many of which are never published, or are enforced by legal process.

Taking the past half-year as a criterion, it would thus seem that mining enterprise in these counties—as at present conducted—is a financially disastrous pursuit. We fear, however unpalatable the deduction may be, that it embodies an incontrovertible fact; for the mining results of the last six months may be taken as a fair—indeed a favourable—average of the results of any similar period that may be selected during the last few years. Looking at the matter candidly, it seems impossible to estimate the annual balance of loss over profit, on Cornish and Devon mining, at less than 150,000*l.*, *exclusive* of interest on the capital invested.

In arriving at this general result, we of course take the mining enterprise of the counties as a whole—cautious and reckless, prudent and imprudent. To the reckless and imprudent class of mining—principally got up for the purpose of selling shares—are these unfortunate results to be chiefly attributed. Careful and prudent mining, we are satisfied, yields on the whole a good profit, which, however, is unfortunately much more than balanced by the disastrous losses entailed by recklessness and folly.

Although there have been great advances in the prices of certain shares, the position of the mines in the county generally has not materially changed. The most important improvement has probably been in Clifford Amalgamated, where a bunch of ore has been cut, in the United Mines, in a shallow level, in ground whole to a great depth. It would be a matter of sincere congratulation if something should turn up to relieve the position of Wheal Clifford by discoveries in the older mines connected with it. By itself Clifford is decidedly the richest copper mine in Cornwall; but it is weighed down by the incubus of the United and Consols water, the pumping of which entails a consumption of 50 tons of coal per day, with a corresponding wear and tear of machinery.

Prospectuses have been issued of the *Tywarnhaile* and *Tregurtha Downs and Owen Vean Consols* Mines, both of which are started under respectable auspices to work fairly promising setts. The former mine is in the St. Agnes district, and is in full work; a large sum of money has been already spent upon it, and it is calculated that a further moderate expenditure will place it in a self-supporting state. It has hitherto been carried on under the limited liability system, but the limit of capital being reached, it is now put under the cost-book principle. The Earl of Shrewsbury and Talbot, the premier Earl of England, is one of the Directors. Tregurtha Downs and Owen Vean, in the Marazion district, is an entirely new concern, and is undoubtedly a most fair speculation.

The now famous dispute between Mr. John Michael Williams and the members of his family has extended beyond the metallurgical businesses, in which they were principally interested, to the banking firm of Messrs. Tweedy, Williams, and Co., carrying on business at Truro, Falmouth, and Redruth. Mr. J. M. Williams has now retired from that firm, in consideration of the business of the Redruth branch being given up to him. This branch is consequently now a district bank, under the firm of Messrs. John Michael Williams and Co., and the title of the West Cornwall Bank. This arrangement, which is understood to have been forced on Messrs. Tweedy and the other partners, under the alternative of winding-up the partnership in the Court of Chancery, has been attended with no small amount of excitement and angry feeling among the customers of the bank. As to the matters involved in the suit of *Williams* v. *Williams and others*, negotiations are pending by which a somewhat similar arrangement may be carried out; Mr. J. M. Williams taking the copper-smelting business, and Mr. William Williams and the other members of the family taking the tin-smelting business.

Those interested in mining in the Liskeard and Caradon districts will find, in the work recently published by Messrs. Webb and Geach, of the Stock Exchange, entitled *The History and Progress of Mining in the Caradon and Liskeard District*, a valuable fund of information. With a general description of the district is given a very full account of each mine—showing everything connected with it. The whole is illustrated by two maps by Mr. Brenton Symons, of Truro, in which the position of each sett is marked.

We very much regret to announce the death of Captain Nicholas Tredinnick, of Great Work Mine, who for some years has most deservedly enjoyed the reputation of being one of the ablest agents in West Cornwall. In dealing with a poor mine, which Great Work has recently been, he has shown great skill and prudence, and his loss cannot fail to be felt by the adventurers. His son, a young man under 30, has been appointed by the committee as his successor.

A very curious instance of how certain mining companies are got up, and of the class of people who get them up, has been recently afforded by bankruptcy of *Paul J. Raby*, mine sharebroker, of Redruth, who was examined before Mr. Commissioner Andrews, at the Exeter District Court of Bankruptcy on January 8th. The operations of the bankrupt were carried on principally at Leeds, where he seems to have sold a large number of shares in the East Releath and South Wheal Leisure mines; but the result was that, at the York Assizes of 1861, he was tried, convicted, and sentenced to twelve months imprisonment, for defrauding one Matthew Oathwaite—his clerk, Timothy Smith, being at the same time convicted and sentenced to six months' imprisonment. The bankrupt complained that he was persecuted by Mr. John Blackburn, solicitor and coroner, of Leeds, who is now bringing out the East Releath Mine under the name of the Crowan and and Wendron Tin and Copper Mining Company (Limited). The South Wheal Leisure mine is now being worked by the bankrupt's father.

The old part of Rosewarne United mine, in Gwniear, having been abandoned, it has been started as a new concern, with the name of New Rosewarne mine, under the pursership of Mr. Huthnance, the proprietor of the land, who has got together a respectable body of adventurers.

WALES AND THE BORDERS.

SOUTH WALES.—The report of the deliberations of the Staffordshire iron-masters at their quarterly meetings have given increased impetus to the iron trade of this district, and favourable hopes are entertained for the

future, some good orders have been received from the Continent for bar and railway iron. A large quantity of rails and other descriptions of iron, have been exported to Spain. The proposed alteration in the Spanish Customs' tariff on iron is looked upon with favour in this district and the result may be expected to be important. Furnaces are being erected at Golynos, by Messrs. G. G. Bevan and Co., Northampton. The old furnaces, once worked by Mr. Crawshay, Bailey, and others, have been out of blast for some years. It is said that the Pontymoile tin works will soon be in full operation, and which would be a great advantage to Pontypool, as a large number of additional hands would be employed.

There is not much to report upon as to the coal trade, which remains much the same. The collieries, with a few exceptions, have been kept steadily going, and the men generally on full time. The coal and coke sent to Staffordshire and the Midland counties is becoming an important item in the trade of the district, and several new contracts have lately been entered into. The facilities afforded by the West Midland Railway Company have considerably brightened the aspect of the coal trade in this direction. There has been no alteration in prices. At a meeting of the proprietors of the Swansea canal, held in the middle of the month, it was resolved to open up a virgin coal district, by the construction of a railway to Bryn Annan and Gwaun Cal Gurwen, in connection with their canal at Pontardame.

The total quanties of coal and iron shipped at Cardiff during the past year were: 1,322,531 tons of coal; and 172,352 tons of iron.

The returns from Swansea show an increase both in the exports and imports for 1862 as compared with 1861. The number of ships entering the port last year was 5,676, with an aggregate registered tonnage of 655,847, and the shipping rates received amounted to 15,839*l.* 19*s.* 8½*d.*

The quarterly meeting of the South Wales Institute of Mining Engineers was held at Merthyr Tydvil on the 14th. The papers read at the former meeting were discussed and the following papers read: "On Puddled Steel," by Mr. Parry; "On the Selection and Value of Coke," by Mr. Child; and "On the Long Wall System of Working," by Mr. Hedley.

GLOUCESTERSHIRE.—The imports into Bristol during the past month comprise: 240 tons of pig-iron from Glasgow; 100 tons of lead ore from Padstow; 198 bars of iron from Liverpool; and 22 casks of metal from Rotterdam. Among the exports have been: 200 tons of coal and 100 tons of wrought iron.

During the year 1862, 12,392 tons of coal, and 15,015 tons of iron were shipped at the port of Bristol; against 17,247 tons of coal and 10,989 tons of iron during 1861: showing a decrease of 4,855 tons of coal, but an increase of 5,026 tons of iron. The Customs' duties received at this port for 1862, amounted to 1,317,177*l.* 8*s.* 3*d.*

MIDLAND COUNTIES.

STAFFORDSHIRE AND WARWICKSHIRE.—The iron trade in this district has been healthy and steady. Pig-iron has not been selling very actively, buyers seeming to anticipate that purchases may be made at lower rates as the quarter advances.

Coal and ironstone have been in brisk demand, and the collieries have been actively employed.

The quarterly meetings of the iron-masters were held respectively at Wolverhampton on the 8th; at Birmingham on the 9th; and at Dudley on the 10th of last month. There was not much business transacted, but a cheerful feeling prevailed during all the meetings and a good average quantity of iron was sold.

We give a complete list of the blast-furnaces of Staffordshire and Worcestershire in and out of blast at the commencement of the present year.

Place and Owners.	In.	Out.	Total.
NORTH STAFFORDSHIRE DISTRICT.			
Apedale—J. E. Heathcote	2	2	4
Biddulph Works—Robert Heath	3	0	3
Clough Hall—Trustees of T. Kinnersley	4	0	4
Fenton Park—Lawton and Co.	1	1	2
Goldendale—Williamson, Brothers..	4	0	4
Lane End, Longton—W. H. Sparrow and Son ..	2	1	3
Shelton—Earl Granville	7	1	8
Silverdale—F. Stanier and Son	4	0	4
Talk-o'-th'-Hill—North Staffordshire Coal and Iron Co...	0	2	2
	27	7	34
WOLVERHAMPTON AND BILSTON DISTRICT.			
Barborsfield—Shale and Fowler	1	1	2
Bentley—Chillington Iron Co.	2	0	2
Birchills—Williams Brothers	0	2	2
Birchills, Walsall—John Jones	4	1	5
Bovereux, Bilston—William Baldwin and Co. ..	0	2	2
Bradley—G. B. Thorneycroft and Co.	2	0	2
Broadwaters—S. Groucutt and Sons	3	0	3
Bilston Brook—Benjamin Gibbons	1	2	3
Capponfield—John Bagnall and Sons	2	1	3
Chillington—Chillington Iron Company	3	1	4
Coseley, Bilston—Jos. and Thomas Turley ..	2	0	2
Crook Hay—W. and G. Firmstone..	0	4	4
Darlaston Green—Samuel Mills	3	0	3
Deepfields, Bilston—W. Gibbons	1	2	3
Dudley Port—John Hopkins and Son	1	1	2
Gold's Green, West Bromwich—John Bagnall and Sons	2	1	3
Hatherton—Hartland and Company	1	1	2
Herbert's Park, Bilston—David Jones	0	1	1
Horseley, Tipton—Colbourn and Sons	4	0	4
Millfield, Bilston—Benjamin Gibbon	4	0	4
Moseley—Chillington Iron Co.	0	3	3
New Furnaces, Bilston—S. H. Blackwell and Co...	0	5	5
Oldbury—William Bennitt	4	0	4
Old Park, Wednesbury—Lloyds, Foster and Co. ..	3	0	3
Osier Bed—Osier Bed Iron Co.	2	1	3
Parkfield—Parkfield Iron Co.	5	0	5
Park Lane, Tipton—Thomas Morris	1	1	2
Pelsall—Davis, Bloomer and Son	2	1	3
Priestfield—W. M. Ward and Sons	2	1	3
,, New—Ditto ditto	1	1	2
Prior's Field—H. B. Whitehouse	3	0	3
Rough Hay, Darlaston—Addenbrookes, Smith and Pidock	2	1	3
Roughwood—F. C. Perry (late)	0	2	2
Spring Vale, Bilston—Jones and Murcott	0	3	3
Stone Field—Stone Field Company..	1	0	1

Place and Owners.	In.	Out.	Total.
Stow Heath —W. H. Sparrow and Co.	3	1	4
Stour Valley—W. J. and G. Onions	2	0	2
Tipton—E. Cresswell and Sons	2	0	2
Tipton Green—Roberts and Humfrey	3	1	4
Union—Phillip Williams and Co.	3	0	3
Wednesbury Oak—Ditto ditto	2	1	3
Willenhall—Fletcher, Solly, and Urwick	3	0	3
Willingsworth—Job and Henry Haines	3	0	3
Wolverhampton—Isiah Aston and Company ..	2	1	3
	85	43	128
DUDLEY DISTRICT.			
Brettell Lane—Hall, Holcroft, and Pearsons ..	2	0	2
Coneygree, Tipton—Earl of Dudley	2	1	3
Corbyn's Hall, Dudley—William Mathews ..	2	2	4
„ New, Dudley—B. Gibbons	2	2	4
Corngeaves—New British Iron Co...	4	2	6
Dixon's Green, Dudley—William Haden	1	0	1
Kotley's, Dudley—B. Gibbons	0	3	3
Lays, Stourbridge—G. and W. Firmstone.. ..	3	0	3
Level, New, Brierley Hill—Earl of Dudley ..	3	0	3
„ Old, „ „ Hall, Holcroft, and Pearson	0	2	2
Netherton—M. and W. Grazebrook	2	0	2
Netherton and Dudley Wood—Noah Hingley and Sons	3	1	4
Oak Farm, Dudley—G. and W. Firmstone ..	2	0	2
Old Hill, Dudley—T. and J. Badger	0	2	2
Park Head—Evers and Martin	1	1	2
Russell's Hall, Dudley—S. H. Blackwell and Co...	3	2	5
Shut End, Kingswinford—John Bradley and Co...	2	2	4
Windmill End (Old)—Samuel Griffiths	0	3	3
Withymoor—William Henry Dawes	2	0	2
Woodside—Cochrane and Company	2	1	3
	36	24	60

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—The iron trade in this district maintains its buoyancy, and with few exceptions the blast-furnaces of Cleveland and South Durham are all in blast. During 1862 five new furnaces were erected in the Cleveland district, and six old ones re-lighted, the total number of furnaces being 71. The quantity of pig-iron produced from them amounted to 705,529 tons.

There is nothing to report upon in the coal trade since our last. Several collieries have been working short time, and only a small proportion of the whole have been in full work.

The chemical and shipbuilding trades have been firm. The exports from the Tyne during the month comprise:—75,299 tons of coal; 55,946 cwts. of iron; 9,605 tons of coke. Among the imports have been: cargoes of pyrites from Pomaron; bars of lead from Carthagena and Garrucha; cargoes of sulphur pyrites from Rotterdam; and 280 tons of iron ore, and 925 bars of lead from Palomeeres.

At a recent meeting of the ironmasters of the important iron-producing district of Cleveland, the following results were arrived at from actual returns made by each firm to the meeting :—

Total number of furnaces erected	80	
In blast, January 1, 1863	59	
Out of blast, January 1, 1863	21	
Production of pig-iron for the year 1862	630,000	Tons
Stock of pig-iron in the whole district on Dec. 31, 1862 ..	25,964	„

And inclusive of iron in store.

SCOTLAND.

Coals have been in good demand for home use and for shipment. The accounts from the principal shipping ports show a considerable increase as compared with the corresponding month last year.

The pig-iron market has been depressed, but rallied a little towards the end of the month.

It is said that the malleable iron-works, belonging to the Monkland Iron and Steel Company, at Calderbank, are about to be put in activity, to fulfil a large Government order.

The computed make of Scotch pig-iron last year was, in round figures, 1,080,000 tons, as compared with 1,010,000 in 1861, 990,000 tons in 1860, 960,000 tons in 1859, 980,000 tons in 1858, 910,000 tons in 1857, 820,000 tons in 1856, 822,000 tons in 1855, 775,000 tons in 1854, 710,000 tons in 1853, 770,000 tons in 1852, and 775,000 tons in 1851. The production last year, therefore, showed an increase of 305,000 tons, or 39·35 per cent., as compared with 1851,—an astonishing advance in so brief a period. The total consumption scarcely kept pace with the production, having amounted to 978,000 tons last year as compared with 935,000 tons in 1861, 917,000 tons in 1860, 910,000 tons in 1859, 833,000 tons in 1858, 840,000 tons in 1857, 830,000 tons in 1856, 842,000 tons in 1855, 885,000 tons in 1854, 935,000 tons in 1853, 680,000 tons in 1852, and 695,000 tons in 1851. The consumption last year, therefore, showed an increase of 283,000 tons, or 40·72 per cent. as compared with 1851, the deliveries last year having been in excess of any former 12 months, notwithstanding the general depression of trade. The stock, however, increased 102,000 tons last year; 75,000 tons in 1861, 73,000 tons in 1860, 50,000 tons in 1859, 147,000 tons in 1858, 70,000 tons in 1857, 90,000 tons in 1852, and 80,000 in 1851; in 1856 it decreased 10,000 tons; in 1855, 20,000; in 1854, 80,000; and in 1853, 225,000 tons; but the general result was to increase the stock, December 31, 1862, to 637,000 tons, as compared with 350,000 tons, December 31, 1851. The shipments last year amounted to 571,000 tons, and the local consumption to 407,000 tons; in 1861 the shipments were 585,000 tons, and the local consumption 350,000 tons; in 1860 the shipments were 567,000 tons, and the local consumption 350,000 tons; in 1859 the shipments were 567,000 tons, and the local consumption 343,000 tons; in 1858 the shipments were 558,000 tons, and the local consumption 275,000 tons; in 1857 the shipments were 528,000 tons, and the local consumption 312,000 tons; in 1856 the shipments were 505,000 tons, and the local consumption 325,000 tons; in 1855 the shipments were 542,000 tons and the local consumption 300,000 tons; in 1854 the shipments were 585,000 tons, and the local consumption 300,000 tons; in 1853 the shipments were 635,000 tons, and the local consumption 300,000 tons; in 1852 the shipments were 434,900 tons, and the local consumption 245,100 tons; and in 1851 the shipments were 452,700 tons, and the local consumption 242,300 tons. The average number of furnaces in blast last year was 120, as compared with 123 in 1861, 121 in 1860, 124 in 1859, 129 in 1858, 128

in 1857, 117 in 1856, 117 in 1855, 116 in 1854, 111 in 1853, 110 in 1852 and 114 in 1851. The increase in the number of furnaces in blast was consequently only 5·26 per cent. last year, as compared with 1851, while the production increased in the same period as before indicated 39·35 per cent.; this discrepancy is to be attributed to the large increase in the results obtained from each furnace of late years. Notwithstanding the growth of the stock the average price realized last year was 53*s.* per ton as compared with 49*s.* 3*d.* per ton in 1861, 53*s.* 6*d.* per ton in 1860, 51*s.* 9*d.* per ton in 1859, 54*s.* 5*d.* per ton in 1858, 69*s.* 3*d.* per ton in 1857, 72*s.* 6*d.* per ton in 1856, 70*s.* 9*d.* per ton in 1855, 79*s.* 8*d.* per ton in 1854, 61*s.* 5*d.* per ton in 1853, 45*s.* 3*d.* per ton in 1852, and 40*s.* per ton in 1851. The increase experienced in the demand last year, and the consequent firmness in prices is attributed to the large demand for iron for shipbuilding purposes, —a demand quite unprecedented, especially since the impetus imparted to it by the famous action between the Monitor and the Merrimac.

THE CONTINENT.

FRANCE.—In the Haute-Marne district prices have latterly had a drooping tendency. In the middle of the month there was a sudden rise in the price of charcoal pig iron 5*l.* 12*s.* to 5*l.* 18*s.* This advance, however, has not been maintained, and last advices give 5*l.* 12*s.* as a maximum price. Manufactured iron has also fallen; mixed rolled descriptions have been done at 9*l.* per ton, and charcoal makes at 9*l.* 8*s.* Two furnaces at Châteauvillain have been put out of blast, and altogether business generally has been in an unsatisfactory condition.

BELGIUM.—It is reported that several important contracts for rails have been entered into for home as well as for foreign consumption. The quantity of English pig imported into this country during 1862 was 2,800 tons, showing an increase of 800 tons over 1861. The importation of Swedish cast-steel also showed an increase last year, the quantity being 404 tons, as compared with 172 tons in 1861.

Metal Markets.

LONDON, *January 29th.*—The new year has not yet brought activity to the metal market, which has been very quiet all through the month. The reports brought by the Bombay mail have had a depressing effect, the orders being very limited; the Continental demand has been the best feature.

IRON.—The iron trade has been quiet through the month, and there has been but a moderate demand for most descriptions.

The Scotch pig-iron market opened sluggish without much business doing, but improved a little in tone towards the end of the month. The demand for consumption and export has been moderate and hardly up to expectations. Prices have varied very little, last quotations showing an increase of 3*d.* per ton during the month. The exports during January amounted to 27,617 tons against 34,133 tons the same month last year, showing a *decrease* of 6,516 tons.

Welsh bars opened quiet and in limited demand, but improved towards the end of the month: prices ranged from 5*l.* 12*s.* 6*d.* to 5*l.* 15*s.* at the works, and 6*l.* 7*s.* 6*d.* to 6*l.* 10*s.* f. o. b. in London. Staffordshire descriptions have been in good steady rquest, sellers realising full rates. Swedish bars improved a little towards the end of the month, though the

demand has been quiet; the improvement may be attributed to the small stock and the difficulty of buying for arrival. Good Indian specifications have been steady at 11*l.* 10*s.* to 11*l.* 15*s.*

STEEL.—Swedish keg has been held firmly at 16*l.*; faggot 17*l.*

COPPER.—The demand both for raw and manufactured has been very dull, and the transactions which have been reported were under fixed prices. For tough ingot there has been rather more enquiry, and contracts have passed at about 96*l.* Foreign has been extremely quiet; Burra Burra 98*l.* to 99*l.*, Kapunda 100*l.*, Chili 88*l.*

YELLOW METAL.—This metal has had a very dull market. Braziery sheets only realised 8*d.* to 8¼*d.*, sheathing 8½*d.* to 8¾*d.*

TIN.—All through the early part of the month the demand for tin was very limited; English being obtainable at about 30*s.* per ton under fixed rates. After the arrival of the China mail however, the market became active and a large speculative business was done, official prices being maintained. A considerable speculative business has been done in Straits, fully 8,000 slabs having changed hands at from 117*l.* to 118*l.* 10*s.* cash, and 119*l.* three months prompt, and the market closes firm at these prices. Banca, has been neglected at 119*l.* The Dutch market has been firm at 69f.

TIN PLATES.—This article has been in fair demand and towards the end of the month coke particularly was more enquired for. I. C. coke was quoted at 22*s.* 6*d.* to 23*s.* Special brands were held for 24*s.*; and large purchases were effected both in coke and charcoal.

LEAD.—English pig has been in moderate request at 21*l.* 10*s.* for ordinary soft quality. W. B. 22*l.* to 22*l.* 5*s.*

SPELTER.—This metal has been steady all through the month although not much business has been doing. On the spot 18*l.* 2*s.* 6*d.* buyers. W. H. 18*l.* 15*s.*

HONG KONG, *December* 1.—LEAD.—Sales about 2,500 piculs. W. B. mark quoted 7 dollars 50 cents; common, 7 dollars, 20 cents.

IRON.—Nailrod 2 dollars 40 cents to 2 dollars 80 cents. Sales at Hong Kong and Canton about 4,000 piculs.

BOMBAY, *December* 26.—The market for nearly all kinds of metals is depressed.

COPPER.—This metal has declined 8 annas.

IRON.—Swedish bars have fallen 2 rs., and are not enquired for. Nailrods are about 1 rupee lower.

LEAD.—This article is in moderate request. Red and white lead are in demand, but the former has receded 4 annas.

TIN PLATES.—This article has been in little request.

Metallic-Ore Markets.

TIN.—There has been no alteration in the tin standard since our last; it therefore remains at—

Superior Fine	.. £107	....	Superior Common	..	£103
Second Fine	.. 105	....	Second Common	..	102

Although there is no change in the tin standard, yet there has been good demand for refined tin, but common has been in limited request. The mail from Singapore brought advices that the demand for Japan continued, and that the shipments to Europe have been entirely suspended, consequently the tin now on the way is only about 400 tons, against 1,300 tons last year. A rise in the standard may soon be expected.

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard have been as follows:—

Date.	Tons.	Produce.	Fine Copper. Tons. cwt.	Price per ton.	Standard.
Dec. 24.	2,393	6¼	150 3	£5 3 0	£125 16 0
Jan. 1.	3,156	6¾	207 12	5 12 0	126 2 0
„ 8.	2,356	6¼	153 18	5 10 0	127 1 0
„ 22.	5,926	5¾	334 3	4 9 6	128 6 0

At the sale of the 24th the standard advanced 2*l.* according to the *Mining Journal*, but 1*l.* 10*s.* according to the *West Briton*. At the sale of January 1st it again advanced 2*l.* according to the *Mining Journal*, but only 22*s.* according to the *West Briton*. At the sale of the 8th the advance was 1*l.* At the sale of the 22nd the standard declined 3*l.*

LEAD.—Comparing the sales of this month with those of last month we find that the prices are on an average much the same.

Coal Markets.

LONDON.—From the returns of the Registrar of the London Coal Exchange, of the quantity of sea-borne Coal, Culm, and Cinders, imported into London in the month of December, we learn that the total quantity was 348,054 tons, against 365,039 tons during the corresponding month of last year, showing a *decrease* of 16,985 tons. The total quantity imported during the twelve months ended December 31st, was 3,442,402 tons against 3,567,002 tons during the corresponding period last year—showing a *decrease* of 124,600 tons.

The following are the particulars of the 348,054 tons imported during December:—

Newcastle	137,593 tons,	in 356	ships
Seaham	20,191 „	78	„
Sunderland	106,060 „	259	„
Middlesbro'	6,399 „	24	„
Hartlepool	50,828 „	169	„
Blyth	2,650 „	10	„
Scotland	4,191 tons,	in 19	ships
Wales	11,764 „	29	„
Yorkshire	4,796 „	41	„
Small	1,436 „	4	„
Cinders	2,146 „	8	„

On the 26th of December, in consequence of the Christmas holidays, no market was held. On the 29th, the arrival of 132 fresh ships, together with the return of mild weather, caused a dull market for all descriptions. The prices for the different kinds were:—best house coal 17*s.* 3*d.* to 18*s.*; seconds 15*s.* 6*d.* to 16*s.* 6*d.*; Hartley's 13*s.* to 14*s.*; manufacturers' 13*s.* to 15*s.* per ton. On the 31st, only 32 ships arrived, the tone of the market was dull throughout, but prices were supported in the few sales effected. On January 2nd, there were few arrivals and very little enquiry for house coal, the amount of business transacted being very trifling, at last prices. Hartley's met a more ready sale, and advanced 3*d.* per ton.; in manufacturers' there was no alteration. On the 5th, 24 fresh ships having come forward there was more disposition to purchase coal generally, and a considerable amount of business was done, at last quotations. On the 7th, there were few arrivals, and the tone of the market was stronger, last quotations being fully realised for all descriptions. On the 9th, colder weather caused a brisk enquiry for both house and steam coal, and prices advanced 6*d.* per ton. On the 12th, 80 fresh ships arrived, which con-

tained only a moderate quantity of house coal, for which there was ample demand, at an advance of 6*d.* per ton: Hartley's were scarce, and rose 1*s.* per ton. On the 14th, there were few arrivals, and the demand was steady for all descriptions, at last quotations. On the 16th, there were large arrivals, and the weather being cold, a good business was done, only 10 cargoes remaining over at the close of the market. On the 19th, the very stormy weather having stopped the progress of the laden vessels, but few reached the market, those on sale met a fair demand at last quotations. On the 21st, the weather being mild, and a large fleet at sea, the tone of business was quiet, prices remaining the same. On the 23rd, there were a great many arrivals, but still larger supplies being looked for, there was an indisposition to do business, prices remaining unaltered.

General Exports of Coal.—From Messrs. J. and T. Platt's Coal Circular for January, we find that the quantity of *coal, cannel, coke, and patent fuel shipped from Liverpool* to foreign and colonial ports during the month of December was 7,331 against 9,747 tons, during the corresponding month of last year—showing a *decrease* of 2,416 tons.

London Share Market.

London, January 29th, 1863.

During the past month the market has been characterized by a remarkable buoyancy. With few exceptions all the leading mines have had a large rise, and the demand still continues great for favourite stock. To a certain extent this improved tone has been justified by improvements in the mines; but as a whole we fear it must be considered as an unnatural inflation, to be followed sooner or later by a period of reaction. By many it might be supposed that the check which the articles in the *Times*, and the rise in the Bank rate of discount, has given to the excessive multiplication of Joint Stock schemes that has characterized the past year, would have been unfavourable to inflated prices for mining shares; but a longer experience shows that this market is really entirely independent of the general money market, and in fact flourishes more vigorously when ordinary trade and speculation is flat. This being settling-day there has been little doing, but as far as seen the advance of the Bank rate to 5*s.* per cent. has flattened the market.

The greatest amount of business has been done in *North Roskear* shares, which at one time had advanced as much as 14*l.* per share on our last quotation. They opened at 48½*l.*-50*l.*, but the large demand caused a rapid rise, and on the 8th they were in great request at 58*l.*-59*l.* They continued firm at advancing prices until the 17th, when they reached 64½*l.*-65*l.* They fluctuated between 62*l.* and 64*l.* until the 21st, since which date they have rather declined and close 53½*l.*-54½*l.* *North Crofty* shares have been steady, without much fluctuations at 5*l.*-5¼*l.*, but close weaker at 4¾*l.*-5*l.* *South Crofty* shares have more than doubled in price during the month They opened 12½*l.*-13*l.* and close 33*l.*-34*l.*

A large and fluctuating business has been done in *East Caradon*. Shares opened at 42*l.*-42½*l.*, but they soon rose to 44*l.*-45*l.*, at which they were largely dealt in, and continued active at advancing prices until the 13th. From this date until the 23rd, they fluctuated daily between 47*l.* and 48*l.*, and close at 48½*l.*-48¾*l.* *West Caradon* shares have advanced 6*l.* per share during the month. They opened 26*l.*-28*l.*, and close 32*l.*-33*l.* *South Caradon*, 390*l.*-400*l.* *Gonamena*, 2½*l.*-3*l.* *South Caradon Wheal Hooper*, 15*s.*-20*s.* *Wheal Pollard*, 15*s.*-17*s.*

A large business has been done in *Wheal Seton* at advanced prices. Shares opened at 197½*l.*-202*l.* at which price they were scarce and in great request. On the 4th they were quoted 245*l.*-250*l.*, and on the 19th had reached 270*l.*-280*l.*, but they have since declined, and close 230*l.*-235*l.* *West Seton*, 285*l.*-290*l.* *New Seton* shares advanced from 140*l.*-145*l.* to 150*l.*-160*l.*, but have again receded to the former quotation. *South Seton*, 25*l.*-26*l.*

West Tolgus shares have advanced 10*l.* per share, and have been in active demand. They opened 52½*l.*-54*l.* On the 14th they were in great request at 59*l.*-61*l.* On the 23rd they reached 64*l.*-66*l.*, but close at a slight reduction, being last quoted at 62*l.*-63*l.* A good deal of business has also been done in *South Tolgus*. Shares opened at 44*l.*-46*l.* at which they were in great demand. They have steadily advanced all through the month and close at 50*l.*-52*l.* *Great South Tolgus* shares have receded in price, from 7*l.*-7¼*l.* to 6⅜*l.*-6¾*l.* *Wheal Union*. 5¾*l.*-6*l.* *Wheal Uny*, 7*l.*-7¼*l.* *South Carn Brea*, 2¼*l.*-2¾*l.*

Wheal Harriett shares have been largely dealt in, and have made a great advance in price. They opened 2¼*l.*-2⅝*l.* and steadily advanced to 5⅝*l.*-6*l.*, but close flatter, at 5¼*l.*-5⅝*l.* *Stray Park* shares made an advance which however has not been maintained. They opened at 40*l.*-41*l.*, and rose to 44*l.*-45*l.*, but close at about the opening price. *Carn Camborne*, 15*s.*-17*s.*

Cargoll shares have been in fair demand and have advanced on our last quotations. They opened at 38*l.*-40*l.*, but on the 8th were active at 41*l.*-43*l.*; and close at 42*l.*-44*l.* *Wheal Ludcott* shares have slightly receded in price, though a fair amount of business has been transacted. They opened 9¾*l.*-10*l.*, and close 9¼*l.*-9½*l.* *Herodsfoot* 49*l.*-50*l.* *Wheal Mary Ann* 16*l.*-16½*l.* *Wheal Trelawny* 16½*l.*-17½*l.* *South Herodsfoot* 5*l.*-5½*l.*

A good deal of business has been done in *Wheal Crebor* and shares have advanced considerably. They opened at 7*s.*-9*s.* and close at 18*s.*-20*s.* *East Russell* shares have been largely dealt and fluctuated constantly in price. They opened at 3½*l.*-4*l.*, but reached 6*l.*-6⅜*l.*—from which they have receded to 5¼*l.*-5½*l.* *Devon Great Consols* shares have been dealt in the latter part of the month, and have advanced from 500*l.* 510*l.*-520*l.*, at which they close. *Drake Walls* shares have also been largely dealt in at the end of the month. They opened at ⅞-1*l.* and rose to 2¾*l.*-3*l.*, closing at 2*l.*-2¼*l.* *Kelly Bray* ⅜-⅝. *Lady Bertha* 1*l.*-1¼*l.*

Marke Valley shares have not altered in price being quoted at 8¾*l.*-9*l.* *South Phœnix* 2⅝*l.*-2⅞*l.* *North Phœnix* 7*l.*-7½. *West Rose Down* 16*l.*-18*l.*

A considerable amount of business has been done in the Grenvilles. *Wheal Grenville* shares opened at 4½*l.*-4¾*l.* and rose to 5¾*l.*-6*l.*, but close at 5*l.*-5½*l.* *East Grenville* shares opened at 48*s.*-50*s.* and rose to 50*s.*-52*s.* 6*d.*, but close 47*s.* 6*d.*-50*s.* *West Frances* shares have advanced considerably during the month. They opened at 12*l.*-13*l.* On the 23rd they reached 20*l.*-22*l.*, at which they were in demand, but close flatter at 17*l.*-19*l.*

The Lelant mines still continue flat. *Providence* 42*l.*-43*l.* *Wheal Margaret* 40*l.*-41*l.* *Rosewall Hill and Ransom United* 3⅝*l.*-3⅞*l.* *Wheal Reeth* 39*l.*-41*l.*

East Basset shares have slightly advanced on our last quotations, the last price being 54*l.*-55*l.* *Wheal Basset* 77½*l.*-82½*l.* *North Basset* 2¾*l.*-3*l.* *South Basset* 8*l.*-8½*l.* *West Basset* 13*l.*-14*l.* *Wheal Buller* 55*l.*-60*l.*

Tincroft shares have been in much request towards the close of the month and have advanced upwards of 2*l.* per share. They opened 13*l.*-13½*l.* and close 15⅜*l.*-15⅝*l.* *Cook's Kitchen* shares have slightly receded. They opened 32*l.*-34*l.*, and close 31½*l.*-32½*l.* *Dolcoath* shares have advanced from 560*l.*-570*l.* to 600*l.*-605*l.*, at which they close. *Condurrow* shares opened at 100*l.*-105*l.* and rose to 105*l.*-110*l.*, but close 90*l.*-100*l.* *Illogan Mines* 15*s.*-20*s.*

East Carn Brea shares remain with little alteration at the prices last quoted, at 11$\frac{3}{4}$*l.*-11$\frac{7}{8}$*l.* *South Frances*, 90*l.*-95*l.*

Clifford Amalgamated shares have advanced in price during the month. They opened 20*l.*-21*l.*, and close 24*l.*-25*l.* *Clijah and Wentworth*, 5*l.*-6*l.* *West Damsel* shares have receded in price from 70*l.*-75*l.* to 60*l.*-62$\frac{1}{2}$*l.*

Wheal Kitty (St. Agnes) shares have been in good demand. They opened 3$\frac{3}{4}$*l.*-4$\frac{1}{4}$*l.*, and close in request at 4$\frac{5}{8}$*l.*-4$\frac{7}{8}$*l.* A good deal of business has been done in *East Rosewarne*, although shares have not fluctuated much. They opened 2*l.*-2$\frac{1}{4}$*l.*, and close 3*l.*-3$\frac{1}{4}$*l.* *Pendeen Consols*, 5$\frac{3}{8}$*l.*-6$\frac{1}{8}$*l.* *North Treskerby*, 4$\frac{1}{4}$*l.*-4$\frac{1}{2}$*l.* *North Downs*, 2$\frac{3}{4}$*l.*-3*l.*

Great Wheal Fortune shares have been firm at slightly advanced prices. They opened 30*l.*-31*l.*, reached 31$\frac{1}{2}$*l.*-32$\frac{1}{2}$*l.*, and close 31*l.*-32*l.* *Wheal Grylls*, 31*l.*-33*l.* *Calvadnack*, 6*l.*-6$\frac{1}{4}$*l.*

Transactions are also reported in the following mines:—*Rosewarne Consols*, 3*l.*-3$\frac{1}{4}$*l.* *Bottle Hill*, 10*s.*-12*s.* *West Trevelyan*, 8*s.*-10*s.* *East Wheal Agar*, 8*l.*-9*l.* *Worvas Downs*, 7*l.*-7$\frac{1}{2}$*l.* *Grambler and St. Aubyn*, 18*l.*-20*l.* *Great Retallack*, 11*s.*-13*s.* *Tolvadden*, 3$\frac{1}{8}$*l.*-3$\frac{1}{4}$*l.* *Redmoor*, 13*s.*-14*s.* *Wheal Unity*, 11*s.* 6*d.*-12*s.* 6*d.* *Par Consols*, 5*l.*-6*l.* *Sortridge Consols*, 9*s.*-10*s.* *St. Just United*, 2$\frac{3}{4}$*l.*-3*l.* *Hingston Down*, 3*l.*-3$\frac{1}{4}$*l.* *Glasgow Caradon Consols*, 3$\frac{1}{2}$*l.* *Caradon Vale*, 5$\frac{1}{4}$*l.*

In colonial and foreign mines prices have been quoted as follows:—*Yudanamutana* opened at 3$\frac{1}{2}$-3$\frac{3}{8}$, and close at 3$\frac{3}{8}$-3$\frac{1}{4}$. *Dun Mountain*, $\frac{3}{8}$-$\frac{1}{2}$. *Scottish Australian*, 1$\frac{3}{8}$-1$\frac{1}{4}$. *Australian*, 1$\frac{1}{8}$-1$\frac{1}{4}$, *Kapunda*, 1$\frac{1}{8}$. *Worthing*, $\frac{1}{2}$. *East Del Rey*, 1$\frac{7}{8}$. *Fortuna*, 4$\frac{3}{8}$-4$\frac{1}{2}$. *Montes Aureos*, 2$\frac{3}{4}$-2$\frac{7}{8}$. *St. John Del Rey*, 56-56$\frac{1}{4}$. *United Mexican*, 5$\frac{1}{4}$-5$\frac{3}{4}$. *Cobre*, 20$\frac{1}{2}$-21. *Mariquita*, $\frac{7}{8}$-1. *Santa Barbara*, $\frac{3}{8}$-$\frac{3}{4}$. *Lusitanian*, 1$\frac{7}{8}$.

New undertakings have been quoted at the following prices:—*East Clogan*, $\frac{1}{8}$ dis. to $\frac{1}{8}$ prem. *West Clogan*, $\frac{1}{4}$ dis. to par. *St. David's*, $\frac{1}{4}$ dis. to par. *Sovereign*, $\frac{1}{8}$ dis. to $\frac{1}{8}$ prem. *St. Cuthbert's*, $\frac{3}{8}$-$\frac{5}{8}$ prem. *Nova Scotia*, $\frac{3}{8}$-$\frac{1}{8}$ dis. *Cape of Good Hope*, 1$\frac{3}{4}$-2 prem. *Dolfrwynog*, $\frac{1}{8}$ dis. to $\frac{1}{8}$ prem. *East Cambrian*, par. to $\frac{1}{4}$ prem. *Ramsay Lead Mine*, $\frac{1}{8}$-$\frac{3}{8}$ prem.

Provincial Share Markets.

DUBLIN.—The following is condensed from the *Mining Journal*:—

The mining market has been very active all through the month and a large business has been done. *Wicklow Copper Shares* have been in active demand: they opened at 39*l.*, at which price they were in great request. The demand continuing they rose to 40*l.* on the 17th; and close firm at 40*l.* 10*s.* to 40*l.* 15*s.*, and a large business doing. *Mining Company of Ireland*, shares have not fluctuated much but have been freely taken at 19*l.* 15*s.* In the beginning of the month *General Mining Company for Ireland shares* were dull and receded from 5*l.* 7*s.* 6*d.* to 5*l.* Towards the middle of the month they rallied a little, and realised 5*l.* 2*s.* 6*d.* to 5*l.* 5*s.* at which latter price they close. *Connorree* shares have receded in price and changed hands at 21*s.* *Carysfort* shares (1*l.* paid) have been weak and realised only 19*s.* 6*d.*

CORNWALL.—The following is condensed from the *West Briton*:—

The Cornish mine share market has shared in the general activity, and a large amount of business has been done. *Copper Hill* shares have steadily advanced through the month. They open at 63*l.*, and close 68*l.*-70*l.* *East Pool* shares have advanced 30*l.* per share, the last price being 450*l.* buyers; *Emily Henrietta* 9*l.*; *Trelyon Consols* 13*l.*-14*l.*; *Wendron Consols* 11*l.*

Tabular Abstract of Mining Accounts for the Month.

Date of Meeting	Name of Mine, and Number of Shares.	Balances. Debit.	Balances. Credit.	Calls. Per Share.	Calls. Total.	Dividends. Per Share.	Dividends. Total.
	CORNISH AND DEVON MINES.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Dec. 22	Great North Downs (6,000) ...	2,719 3 10	—	0 10 0	3,000 0 0	—	—
,, 22	Nangiles (1,024) ...	1,557 18 6	—	1 10 0	1,536 0 0	—	—
,, 22	East Providence (4,096) ...	70 18 9	—	0 2 0	409 12 0	—	—
,, 22	Wheal Vyvyan (1,024) ...	1,565 12 6	—	1 10 0	1,536 0 0	—	—
,, 23	Wheal Grylls (1,024) ...	—	1,097 0 0	—	—	1 0 0	1,024 0 0
,, 23	East Carn Brea (6,000) ...	262 13 3	—	—	—	—	—
,, 23	East Wheal Grylls (2,048) ...	—	669 16 8	—	—	—	—
,, 23	Devon and Cornwall United (4,076) ...	709 19 4	—	—	—	—	—
,, 23	Wheal Arthur (5,990) ...	—	629 0 0	—	—	—	—
,, 23	East Pool (128) ...	—	739 7 9	—	—	5 0 0	640 0 0
,, 23	Pendeen Consols (5,000) ...	—	206 2 4	—	—	—	—
,, 23	South Condurrow (6,138) ...	556 18 5	—	0 2 0	61 216 0	—	—
,, 24	Bedford United (4,000) ...	—	1,292 9 3	—	—	0 2 6	500 0 0
,, 24	Hingston Down Consols (6,000)	166 3 4	—	0 1 0	300 0 0	—	—
,, 25	Great Wheal Busy (6,000) ...	3,760 10 1	—	0 10 0	3,000 0 0	—	—
,, 30	Charlotte United (6,000) ...	2,687 5 11	—	0 8 6	2,550 0 0	—	—
,, 31	West Great Work (4,216) ...	138 16 0	—	0 1 0	210 16 0	—	—
,, 31	Wheal Basset and Grylls (1,000)	—	1,743 11 0	—	—	1 0 0	1,000 0 0
Jan. 3	South Wheal Frances (496) ...	—	2,760 15 0	—	—	1 0 0	496 0 0
,, 3	Wheal Nelson (6,000) ...	1,039 16 2	—	0 5 0	1,500 0 0	—	—
,, 5	East Caradon (6,144) ...	—	6,710 0 0	—	—	1 0 0	6,144 0 0
,, 5	Marke Valley (9,000) ...	—	2,102 6 2	—	—	0 2 6	1,125 0 0
,, 5	Carn Camborne (6000) ...	161 11 1	—	0 1 6	450 0 0	—	—
,, 5	West Rose Down (1,000) ...	32 3 1	—	0 15 0	750 0 0	—	—
,, 6	Grambler and St. Aubyn (486)	224 4 5	—	1 0 0	486 0 0	—	—
,, 6	Ludcott and Wrey (4,800) ...	—	2,517 4 0	—	—	0 10 0	2,400 0 0
,, 7	St. Ives Wheal Allen (1,024)	538 6 1	—	0 10 6	537 12 0	—	—
,, 8	East Gunnis Lake and South Bedford (4,000) ...	502 7 10	—	0 4 0	800 0 0	—	—
,, 9	North Downs (6,000) ...	—	110 9 7	—	—	—	—
,, 12	New Wendron Consols (1,024)	—	—	1 0 0	1,024 0 0	—	—
,, 13	Wheal Kitty (St. Agnes) (4,295)	1,024 0 10	—	—	—	—	—
,, 13	East Devon Great Consols (4,000) ...	402 8 8	—	0 2 6	500 0 0	—	—
,, 13	North Roskear (700) ...	872 0 3	—	1 5 0	875 0 0	—	—
,, 14	East Rosewarne (5,000) ...	66 5 0	—	—	—	—	—
,, 14	Gurlyn (4,910) ...	576 18 10	—	—	—	—	—
,, 15	Trumpet United (4,000) ...	559 15 2	—	0 2 0	400 0 0	—	—
,, 16	Wheal Pollard (6,000) ...	1,004 0 0	—	0 3 0	900 0 0	—	—
,, 16	Treweatha (4,096) ...	600 0 0	—	0 2 6	512 0 0	—	—
,, 16	Tolcarne (6,000) ...	—	264 2 2	—	—	—	—
,, 19	Alfred Consols (4,943) ...	2,128 16 2	—	0 9 0	2,224 7 0	—	—
,, 19	Wheal Emily Henrietta (1,024)	—	31 19 10	0 10 0	512 0 0	—	—
,, 20	Wheal Buller (256) ...	—	555 18 7	—	—	—	—
,, 21	West Wheal Jane (10,000) ...	592 13 7	—	0 2 6	1,250 0 0	—	—
,, 23	Devon Great Consonls (1,024)	—	33,580 0 0	—	—	10 0 0	10,240 0 0
	WELSH MINES.						
Dec. 31	Cwn Erfin (867) ...	—	—	—	—	0 5 0	216 0 0
Jan. 8	Vale of Towy (20,000) ...	382 3 0	—	0 1 0	1,000 0 0	—	—
,, 21	Bryn Gwiog (500) ...	—	472 6 11	—	—	—	—
,, 21	Long Rake (500) ...	350 8 8	—	1 0 0	500 0 0	—	—
,, 21	Billins Lead Mine (200) ...	120 11 0	—	3 0 0	600 0 0	—	—
,, 22	Coed Mawr Pool (3,170) ...	—	—	0 3 0	475 10 0	—	—

Prices Current of Metals.

From Messrs. JAMES and SHAKSPEARE'S, 10, Austin Friars, E.C. 29*th Jan.*

					Per Ton.				
IRON	Bars	in Wales	£5	12	6	@	£5	15	0
	„	„ Liverpool	6	5	0	„	6	10	0
	„	„ London	6	10	0	„	6	15	0
	Nail Rods	„ Wales	—			„	6	5	0
	„ (Staffordshire)	„ Liverpool	6	12	6	„	7	0	0
	„ „	„ London	7	0	0	„	7	10	0
	Hoops „	„ Liverpool	8	0	0	„	8	2	6
	„ „	„ London	8	7	6	„	8	10	0
	Sheets „	„ Liverpool	8	12	6	„	9	5	0
	„ „	„ London	9	5	0	„	9	10	0
	Bars „	„ Liverpool	6	15	0	„	7	0	0
	„ „	„ London	7	7	6	„	7	10	0
	Scotch Pig (No. 1. g.m.b.)	the Clyde	—			„	2	14	6
	Rails	in Wales	—			„	5	15	0
	Swedish—Hammered—large sizes		—			„	11	5	0
	„ „ Indian assortments		—			„	11	10	0
STEEL	Hammered—faggot		—			„	17	0	0
	„ in kegs ¼ and ⅝ in.		—			„	16	0	0
COPPER	Burra and P.C.C.		98	10	0	„	99	0	0
Australian	Kapunda		99	0	0	„	100	0	0
	Wallaroo		98	10	0	„	99	0	0
American	Baltimore		—			„	100	0	0
	Lake Superior		—			„	99	0	0
	Spanish Cake		89	0	0	„	90	0	0
	Chili and other Slab, for 96 per Cent. pure Copper		—			„	86	10	0
English	Tough Cake and Ingot and Tile		96	0	0	„	98	0	0
	Best selected Ingot		99	0	0	„	101	0	0
	Sheets, Sheathing and Rod		102	13	4	„	105	0	0
	Flat Bottoms		107	10	0	„	110	0	0
					Per lb.				
YELLOW METAL	Sheets		—		8¼*d.*		8¼*d.*		
	Sheathing and Rod		—		8¾*d.*		9¼*d.*		
					Per Cwt.				
TIN	Common Blocks and Ingots		—			„	115*s.*		
English	„ Bars (in barrels)		—			„	116*s.*		
	Refined		—			„	120*s.*		
Foreign	Straits, Fine		120*s.*			„	121*s.*		
	Banca		120*s.* 6*d.*			„	121*s.*		
					Per Box.				
TIN PLATES at Liverpool 6*d.* Less	Charcoal IC, best		28*s.* 6*d.*			„	29*s.*		
	„ IX „		34*s.* 6*d.*			„	35*s.*		
	Coke IC		22*s.* 6*d.*			„	24*s.* 6*d.*		
	„ IX		28*s.* 6*d.*			„	30*s.* 6*d.*		
					Per Ton.				
LEAD	Sheet		—			„	£21	10	0
English	Pig—W.B.		—			„	22	5	0
	„ Other good brands		21	5	0	„	21	10	0
	„ German and Spanish, soft		20	12	6	„	20	17	6
English	Red		—			„	21	15	0
	Shot		—			„	23	10	0
	Dry White		—			„	27	0	0
SPELTER	(Silesian) in Cakes		18	5	0	„	18	10	0
ZINC	(Sheet) No. 9 and upwards		23	5	0	„	23	10	0
					Per Bottle.				
QUICKSILVER	(in bottles containing 75lbs. each)		—			„	7	0	0
					Per Ton.				
REGULUS OF ANTIMONY	French Star		—			„	42	0	0

Copper Ores.

Sampled Dec. 10, and sold at Tabb's Hotel, Redruth, Dec. 21.

Mines.	Tons.	Purchasers.	Price.
South Caradon	100	11	£5 14 0
	92	1, 6, 9	7 11 6
	83	6	5 13 6
	57	1, 5	17 6 6
	51	2	7 17 0
	46	1	15 4 6
	25	1, 7	6 3 0
Great Wheal Busy	86	7	2 14 6
	75	10	2 1 0
	55	7	4 3 6
	50	7	2 19 6
	49	9	2 15 0
	39	8	2 3 6
	29	7	3 6 0
	27	7, 10	2 10 0
	19	2	5 4 0
Fowey Consols	96	1, 6	4 15 6
	82	5	5 7 0
	74	1, 5	5 14 0
	72	9	5 17 0
	46	1, 5	5 10 0
West Damsel	81	3	4 7 0
	69	3	4 19 0
	53	3	1 7 6
	52	3	4 1 6

Mines.	Tons.	Purchasers.	Price.
West Damsel	45	3	£5 11 6
Tywarnhaile	77	12	1 15 6
	56	12	2 3 6
	52	6	5 7 6
	35	5, 12	1 17 6
Craddock Moor	87	2, 6	6 15 6
	46	6	8 4 6
	27	10	3 9 6
	11	9	4 16 0
Clifford Amalgamated (United Mines)	54	3	4 16 0
	47	10	1 0 6
	26	7	2 7 6
	23	3	4 5 6
Great Brigan	45	6	8 16 6
	40	6, 7	6 5 6
North Grambler	44	7	4 8 0
	33	7	5 10 6
Carn Camborne	19	8	3 2 6
	16	7	3 3 6
	7	1	9 9 0
Falmouth and Sperries	30	1, 5	3 1 0
Pedn-an-drea	22	6	5 19 6
North Hallenbeagle	20	3	6 11 0
Grambler & St. Aubyn	15	7	4 12 6
Creegbrawse	9	5	5 14 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
South Caradon	454	£3,979 18 0
Great Wheal Busy	428	1,245 6 6
Fowey Consols	370	1,993 2 0
West Damsel	300	1,229 11 0
Tywarnhaile	220	602 14 6
Craddock Moor	171	1,114 8 0
Clifford Amalgamated	150	467 9 0
Great Brigan	85	648 2 6
North Grambler	77	£375 18 6
Carn Camborne	42	376 6 6
Falmouth and Sperries	30	91 10 0
Pedn-an-drea	22	131 9 0
North Hallenbeagle	20	131 0 9
Grambler and St. Aubyn	15	69 7 6
Creegbrawse	9	51 6 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	247¼	£2,181 15 9
2 Freeman and Co.	113¾	793 17 3
3 Grenfell and Sons	397	1,718 1 6
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	212	1,399 5 9
6 Williams, Foster & Co.	390¾	2,539 3 3
7 Mason and Elkington	399	1,499 18 6
8 Bankart and Sons	58	144 4 0
9 Copper Miners' Co.	162¾	£841 1 0
10 Charles Lambert	162¾	329 10 0
11 Newton, Keates & Co.	100	570 0 0
12 Sweetland, Tuttle & Co.	150½	290 17 0
13 Neath Copper Co.	—	—
Total	2393	£12,307 9 0

Average Produce, 6¼.
Quantity of Fine Copper, 150 tons 3 cwt.

Average standard £125 16 0
Average Price per ton 5 3

Copper Ores.

Sampled Dec. 17, and sold at Tabb's Hotel, Redruth, Jan. 1.

Mines.	Tons.	Purchasers.	Price.
Amalgamated	102	7	£5 15 0
heal Clifford)	100	3	6 5 6
	99	2	6 5 0
	98	3, 6	6 5 6
	74	7	4 0 0
	71	7	5 1 0
	70	9	5 13 0
	65	12	5 10 6
	64	7	5 0 0
	60	13	3 14 6
	51	6, 12	3 11 6
ton	113	12	2 18 6
	102	3, 6	8 2 6
	71	6	6 16 6
	64	6	5 15 6
	59	6	4 19 6
	58	8	4 11 0
	55	12	2 19 0
	28	3, 6	8 2 6
olgus	69	3	4 2 6
	68	9	4 18 6
	60	6	5 4 6
	53	3, 6	7 6 6
	12	3	1 12 6
eton	27	13	4 12 6
	5	12	2 19 6
(Pendarves)	73	6	4 8 6
	51	7	5 14 6
	40	7	5 0 0
	10	3	13 15 0
rances	74	9	5 1 6
	55	2	6 13 6

Mines.	Tons.	Purchasers.	Price.
South Frances	50	9, 12	£6 0
	22	5	11 7 0
East Pool	83	6	4 14 6
	64	6	4 9 6
	51	13	4 10 6
Tolcarne	46	10	5 3 0
	44	1	3 5 6
	43	10, 12	2 18 6
	36	1	6 3 0
North Roskear (Enys)	32	1	11 16 6
	27	4, 6	6 0 6
	26	7	2 7 6
(Pendarves)	24	7	4 0 0
(Basset)	23	4, 6	4 7 6
Wheal Basset	52	1	5 2 6
	49	7	5 0 0
	25	7	5 11 0
	17	5, 9	7 14 0
East Basset	36	2	6 11 6
	33	7	5 6 6
	32	9	6 2 6
Wheal Harriet	35	6	3 4 6
	26	3	6 1 6
West Stray Park	59	7, 9	6 17 0
West Tolgus	49	3	5 4 6
Bampfylde	48	5	13 11 0
North Crofty	36	6, 13	6 17 6
North Frances	26	1	5 2 6
South Basset	19	10	3 0 0
Wheal Kitty	15	5	7 17 0
East Tolgus	7	9	4 10 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Amalgamated	854	£4,582 14 0
ston	550	2,960 12 6
Tolgus	262	1,340 15 0
Beton	206	1,092 5 0
Frances	201	1,293 12 6
ol	198	909 7 0
e	169	728 3 6
Roskear	152	1,035 19 0
Basset	143	784 18 0
sset	101	608 8 6

	Tons.	Amount.
Wheal Harriett	61	£270 16 6
West Stray Park	59	404 3 0
West Tolgus	49	256 0 6
Bampfylde	48	650 8 0
North Crofty	36	247 10 0
North Frances	26	138 5 0
South Basset	19	57 0 0
Wheal Kitty	15	117 15 0
East Tolgus	7	31 10 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
n and Sons	210	£1,380 3 0
nan and Co.	190	1,221 11 6
ell and Sons	406½	2,512 16 3
n Copper Co.	35	131 13 0
Willyams & Co.	93½	1,083 6 0
ams, Foster & Co.	718	3,951 19 0
n and Elkington	583½	2,976 1 6
art and Sons	58	263 18 0

	Tons.	Amount.
9 Copper Miners' Co.	314	1,781 12 0
10 Charles Lambert	98½	356 15 9
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	310	1,171 9 0
13 Neath Copper Co.	156	702 18 0
Total	3156	£77,505 3 0

e Produce, 6⅝.
y of Fine Copper, 207 tons, 12 cwt.

Average Standard £126 2 0
Average Price per ton 5 12 0

Copper Ores.

Sampled Dec. 24, and sold at Tabb's Hotel, Redruth, Jan. 8.

Mines.	Tons.	Purchasers.	Price.
West Basset	87	5	£10 13 6
	80	5	4 8 6
	77	10	3 11 6
	72	5	5 15 0
	61	5	5 9 6
	54	5	7 16 6
	33	5	3 19 0
	1	6	25 7 6
East Carn Brea	61	9	5 19 6
	52	2	4 16 0
	51	7	6 9 6
	50	7	8 16 6
	48	3	7 10 6
	39	2	7 2 0
	38	2	6 14 0
	37	3	7 3 0
	23	7	3 10 6
	17	9	4 11 6
	15	8	4 6 6
Alfred Consols	76	7, 12	3 17 6
	68	9	4 9 6
	45	6	3 10 6
	43	6, 13	4 18 0
	41	10	1 12 0
	33	12	1 16 6
Par Consols'	70	1, 6	9 13 6
	66	3, 9	6 11 6
	65	3	7 14 0
Tolvadden'	44	12	3 18 6
Tolvadden	42	7	£5 1 0
	36	1	3 5 6
	32	5	3 11 6
Wheal Margery	45	8	2 9 6
	41	6	7 14 6
	39	1, 6	1 13 6
	5	5	11 9 6
East Rosewarne	38	6	7 18 6
	35	1	12 19 6
	22	6, 12	3 1 6
	20	3, 7	9 1 6
Prosper United	47	7	5 19 6
	32	5	1 10 0
	26	7	5 1 0
Copper Hill	42	7, 12	1 12 6
	30	1	6 19 0
	29	12	2 1 6
North Basset	38	7	3 2 0
	24	8	4 6 6
	22	1	7 2 6
South Crenver	57	7, 12	2 1 6
	21	7, 13	6 9 6
Wheal Buller	39	6	3 14 0
	12	3	12 10 0
Wheal Agar	47	3	5 13 0
Gurlyn	24	4, 6	4 15 0
	23	4, 6	6 2 6
West Trevelyan	23	3	10 0 0
South Carn Brea	18	7, 12	4 2 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
West Basset	465	£2,884 5 0
East Carn Brea	431	2,765 6 6
Alfred Consols	306	1,093 19 0
Par Consols	201	1,611 14 0
Tolvadden	154	616 6 0
Wheal Margery	130	549 11 0
East Rosewarne	115	1,004 8 6
Prosper United	105	460 2 6
Copper Hill	101	£336 18 6
North Basset	84	378 7 0
South Crenver	78	254 5 0
Wheal Buller	51	294 6 0
Wheal Agar	47	265 11 0
Gurlyn	47	254 17 6
West Trevelyan	23	230 0 0
South Carn Brea	18	74 5 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount
1 Vivian and Sons	177½	£1,308 11 3
2 Freeman and Co.	129	781 2 0
3 Grenfell and Sons	275	2,078 6 6
4 Crown Copper Co.	23½	127 8 9
5 Sims, Willyams, & Co.	456	2,802 9 0
6 Williams, Foster & Co.	274½	1,584 1 6
7 Mason and Elkington	394	2,030 19 0
8 Bankart and Sons	84	278 18 6
9 Copper Miners' Co.	179	£963 10 6
10 Charles Lambert	118	340 17 6
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	213½	604 11 3
13 Neath Copper Co.	32	173 6 9
Total	2356	£13,074 2 6

Average Produce, 6½.
Quantity of Fine Copper, 153 tons 18 cwts.

Average Standard £127 1 0
Average Price per ton 5 10 0

No sale January 15th.

Copper Ores.

Sampled Jan. 7, and sold at the Royal Hotel, Truro, Jan. 22.

Mines.	Tons.	Purchasers.	Price.
Devon Great Consols	136	2	£4 16 6
	130	6	4 18 6
	127	8	5 3 6
	126	5, 11	5 11 0
	120	6	5 5 6
	118	10	1 2 6
	115	2, 5	3 13 0
	113	8	4 16 6
	108	5	4 14 0
	101	6	5 2 6
	96	7, 12	3 3 6
	93	12	2 2 6
	90	10	2 4 6
	87	12	4 3 6
	83	1	3 17 6
	80	9	5 8 6
	79	5	9 12 0
	67	1	10 4 0
	64	9	4 3 0
	63	6	5 6 6
	54	2	2 14 6
	42	2	9 17 0
	22	11	9 12 6
Phœnix Mines	92	1	2 9 6
	90	7	1 19 6
	80	1, 7	4 5 6
	75	1, 12	2 12 6
	57	1, 5, 6	7 0 6
	56	7	1 16 6
	50	5	3 5 0
East Carnadon	96	1	4 10 6
	94	1	5 4 0
	90	1	5 9 0
	70	1, 5	10 2 6
	65	1	10 12 6
	60	1, 5	10 9 6
Marke Valley	84	3, 4, 6	3 10 6
	82	4, 6, 8	3 15 6
	80	3	4 9 0
	79	12	3 3 6
	57	10	2 1 0
	38	10	2 2 0
Hingston Down	74	8	3 15 6
	72	9	5 12 6

Mines.	Tons.	Purchasers.	Price.
Hingston Down	63	7	£3 2 0
	62	9	3 1 6
	61	7	2 17 0
	58	8	2 19 6
Great Wheal Martha	85	1, 5	1 9 0
	55	1, 5	1 0 6
	46	1, 5	2 1 6
	43	1, 5	1 19 6
	40	1, 5	3 16 6
East Russell	104	3	5 13 0
	57	7	4 2 0
	35	3, 7	4 7 0
	26	5	6 3 0
	16	1	15 8 6
Holmbush	73	5	3 13 6
	51	1, 6	9 12 6
	45	11	7 5 6
	35	9	8 5 0
Bedford United	103	7, 13	4 1 6
	97	6, 13	3 6 6
Wheal Edward	69	8	3 10 0
	38	5	6 6 0
	37	7	4 10 6
	32	10, 12	1 13 6
Wheal Friendship	84	7	3 4 6
	68	1, 6	10 14 6
Kelly Bray	53	13	5 18 6
	45	10	1 14 6
	43	4, 6	4 14 0
Lady Bertha	52	3, 7	2 19 6
	51	9	2 9 0
	33	5, 10	1 14 6
Wheal Emma	52	1	3 2 6
	51	4, 5, 6	6 6 0
	27	1, 5	2 4 6
Gawton	94	5, 7	2 5 6
Calstock Consols	55	1, 5	2 16 6
	31	1, 5	3 16 0
Brookwood	55	13	3 15 6
	20	5	8 2 6
Gunnis Lake (Clitters)	60	5	5 6 0
Fursdon	23	10, 12	2 0 6
	20	5, 11	5 10 6
Hawkmoor	23	3, 7, 9	5 13 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2,114	£10,045 18 6
Phœnix	506	1,609 9 0
East Caradon	475	3,441 11 6
Marke Valley	420	1,409 2 6
Hingston Down	390	1,416 14 0
Great Wheal Martha	269	513 0 0
East Russell	238	1,380 5 0
Holmbush	204	1,375 5 6
Bedford United	200	742 5 0
Wheal Edward	176	701 18 6
Wheal Friendship	152	£1,000 4 0
Kelly Bray	141	593 15 0
Lady Bertha	136	336 11 6
Wheal Emma	130	543 17 6
Gawton	94	213 17 0
Calstock Consols	86	273 3 6
Brookwood	75	370 2 6
Gunnis Lake (Clitters)	60	318 0 0
Fursdon	43	157 1 6
Hawkmoor	23	129 19 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	1067	£5,851 2 0
2 Freeman and Co.	289½	1,426 18 6
3 Grenfell and Sons	263½	1,239 1 10
4 Crown Copper Co.	93 5-6	410 0 8
5 Sims, Willyams & Co.	940	4,714 6 3
6 Williams, Foster & Co.	634 5-6	3,441 4 2
7 Mason and Elkington	685½	2,158 2 1
8 Bankart and Sons	468½	1,999 0 8
9 Copper Miners' Co.	371½	£1,752 5 4
10 Charles Lambert	392	685 16 0
11 Newton, Keates & Co.	140	888 15 6
12 Sweetland, Tuttle & Co.	372	1,112 12 0
13 Neath Copper Co.	208	892 15 6
Total	5926	£26,572 1 0

Average Produce, 5¼.
Quantity of Fine Copper, 334 tons 3 cwts.

Average Standard £128 6 0
Average Price per ton 4 9 6

Copper Ores.

Sampled Dec. 17, and sold at Swansea Jan. 6.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Cobre	98	13¾	7	£11	7	6
	94	14	7	10	19	6
	80	14	7, 15	11	10	0
	96	14½	6	11	8	0
	88	14½	3, 6	11	11	0
	87	14½	6	11	17	0
	63	14	6	11	12	0
	46	24	5	21	1	6
	38	24	3	20	10	0
	8	17½	1	14	18	6
	9	55½	5	47	1	6
	92	13¾	3	11	12	0
	86	14	7	11	10	6
	85	14½	3, 10	11	12	0
	84	14	1	11	5	0
	62	14	14	11	6	0
	36	24	9	20	13	6
	32	24	3	21	1	0
	8	62	10	50	5	6
Cuba	100	10¾	10	£9	5	0
	95	10½	2, 15	8	19	6
(Precip.) S.I.M.	14	71½	10	58	15	6
	90	10¾	2	9	3	0
	76	10¾	10	9	3	0
	65	18¾	9	16	5	6
	32	16¾	1, 9	14	4	6
(Precip.) A.V.F.	4	80¾	5	68	15	0
Berehaven	90	10¾	7	9	4	6
	62	10¾	7	9	4	6
	108	11¼	2	9	15	0
Laxey	84	3½	3, 6	2	6	0
	55	7½	3, 6	6	9	0
Knockmahon	95	9¾	13	8	12	6
Melbourne	17	18¾	5	15	6	6
Copper Slag	17	10	14	11	7	0
Swedish	14	2½	6	1	7	0
Kanmantoo	6	55½	14	48	11	0
Holyford	4	11¾	1	9	11	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Cobre	1,182	£15,749	10	6
Cuba	476	5,905	1	6
Berehaven	260	2,455	4	0
Laxey	139	547	19	0
Knockmahon	95	819	7	6
Melbourne	17	£260	10	6
Copper Slag	17	192	19	0
Swedish	14	18	18	0
Kanmantoo	6	291	6	0
Holyford	4	38	6	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Copper Miners' Co.	112	£1,330	6	0
2 Freeman and Co.	245½	2,301	12	6
3 Grenfell and Sons	318	3,794	19	6
4 Crown Copper Co.	—	—		
5 Sims, Willyams & Co.	76	1,928	13	0
6 Vivian and Sons	373½	3,657	4	6
7 Williams, Foster & Co.	470	4,999	15	0
8 British and For. Copper Co.	—	—		
9 Mason and Elkington	117	2,033	15	6
10 Bankart and Sons	240¾	£3,338	9	0
11 Charles Lambert	—	—		
12 Ravenhead Copper Co.	—	—		
13 Sweetland, Tuttle & Co.	95	819	7	6
14 Jennings and Co.	85	1,184	17	0
15 Neath Copper Co.	87½	885	2	6
Total	2220	£26,279	2	0

Sundry Copper Ore Sales.

Date.	Mines.		Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Jan. 9.	Koochmahon		50	10 3 6	St. Helen's Co.	
	,,		25	10 4 6	ditto	1523 15 0
	,,		25	10 4 6	Newton, Keates & Co.	
	,,		50	10 1 6	ditto	
,, 21.	,,		25	8 13 6	Newton, Keates & Co.	
	,,		25	8 13 6	St. Helen's Co.	1596 5 0
	,,		60	9 14 0	ditto	
	,,		60	9 13 6	Evans & McBride	
,, 22.	Parys Mines	Lot 1	186	5 15 6	Mona Co.	
	,,	2	174	5 15 0	ditto	2390 18 0
	,,	3	110	2 17 6	J. Hutchinson & Co.	

Blende Sales.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Jan. 2.	Minera	30	2 12 6	A. Courage & Co.	
	,,	55	2 18 0	ditto	368 0 0
	,,	30	1 17 6	ditto	
	,,	20	3 13 6	W. Kenrick	

Copper Ores.

Sampled Dec. 31, and sold at Swansea, Jan. 20.

Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	103	10¾	7	£8 7 6
	100	10¾	7, 15	8 6 0
	99	10¾	3	9 0 0
	98	10¾	3	8 12 0
	84	10½	5, 7	9 2 0
	104	11	5	9 12 0
	102	10¾	7, 15	8 12 6
	97	11	2, 5	9 9 0
	94	11½	10	9 13 0
	105	11¼	7	9 7 6
	92	11⅛	1	9 10 6
	83	11¼	1	9 7 0
Knockmahon	62	11½	2	£9 13 6
	59	11⅝	2	9 16 0
	81	11⅞	9	10 4 6
	68	10⅝	3	9 0 0
	68	10¾	1, 9	9 6 6
	67	11⅛	9	9 11 0
	97	10¼	6	9 5 0
	80	10⅜	1, 9	8 18 0
Cuba	84	10½	7	8 12 6
Worthing Reg,	37	50½	5	42 2 0
Lochwinnoch	12	5	7	3 17 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Cobre	1,161	£10,529 9 0
Knockmahon	591	5,581 11 6
Cuba	84	724 10 0
Worthing Regulus	37	£1,594 14 0
Lochwinnoch	12	46 10 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Copper Miners' Co.	253¾	£2,365 9 0
2 Freeman and Co.	169½	1,636 7 6
3 Grenfell and Sons	265	2,345 16 0
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	231½	3,433 12 6
6 Vivian and Sons	97	897 5 0
7 Williams, Foster & Co.	447	3,855 1 6
8 British and For. Copper Co.	—	—
9 Mason and Elkington	226¼	2,181 3 6
10 Bankart and Sons	94	£907 2 0
11 Charles Lambert	—	—
12 Ravenhead Copper Co.	—	—
13 Sweetland, Tuttle & Co.	—	—
14 Jennings & Co.	—	—
15 Neath Copper Co.	101	854 17 6
Total	1885	£18,470 14 6

Black Tin Sales.

Date.	Mines.	Tons. c. q. lbs.	Price per ton £ s. d.	Purchasers.	Amount of Money. £ s. d.
Dec. 17.	Penhalls	5 12 2 4	—	—	371 7 3
	North Roskear	9 18 0 16	64 0 0	Bissoe Co.	624 9 1
,, 20.	Great Wheal Fortune	27 5 1 23	—	Williams & Co.	1920 0 0
,, 22.	Brea Consols	3 1 2 17	70 0 0	Chyandour Co.	
	,,	0 12 0 24	64 0 0	ditto	261 6 0
	,,	0 2 2 3	51 0 0	ditto	
	Furze Hill Wood	4 0 0 0	67 0 0	R. R. Michell	268 0 0
	Wheal Vyvyan	1 6 3 27	63 0 0	Enthoven and Sons	97 16 7
	,,	0 5 3 8	44 0 0	ditto	
	Trevenen	8 12 3 13	70 0 0	ditto	646 19 10
	,,	0 19 2 2	43 0 0	ditto	
,, 24.	South Carn Brea	4 3 3 18	60 10 0	Bissoe Co.	514 10 3
	,,	4 6 0 0	60 12 6	Carvedras Co.	
	West Beam	16 5 2 14	67 10 6	Enthoven & Sons	694 4 10
,, 27.	Drake Walls	20 10 0 0	—	—	1368 2 6
,, 30.	Great Wheal Busy	19 1 0 3	—	—	1104 19 9
	Tincroft	10 13 3 9	64 0 0	Williams & Co.	
	,,	10 0 0 0	64 0 0	Chyandour Co.	1560 5 0
	,,	4 0 0 0	64 0 0	Bissoe Co.	
Jan. 1.	Wheal Hearle	3 13 2 17	61 15 0	Michell & Co.	264 16 5
	,,	0 12 0 8	62 0 0	ditto	
,, 7.	Garlidna	5 8 3 8	67 0 0	Bissoe Co.	477 19 10
	,,	1 18 1 23	59 0 0	ditto	
	St. Day United	38 14 2 23	—	—	2149 15 6
,, 10.	Kitty (St. Agnes)	15 1 0 17	—	—	963 13 6
	Gurlyn	5 15 3 3	62 10 0	Chyandour Co.	361 16 0
,, 14.	Penhalls	5 9 3 26	—	—	367 14 6
,, 17.	Gt. Wh. Vor United	23 11 0 19	—	—	1603 13 5
	Pedn-an-drea United	11 6 1 6	—	Carvedras Co.	724 5 0
	Polbreen	5 10 3 25	66 0 0	—	371 15 3
	Great Wheal Fortune	31 5 3 21	—	Chyandour Co.	2202 0 6
,, 19.	Leeds and St. Aubyn	1 6 2 11	65 0 0	—	100 17 6
	,,	0 5 0 3	57 10 0	—	

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Dec. 24.	Foxdale	100	21 10 0	Sims, Willyams & Co.	2150 0 0
	Westminster	24	12 12 6	Walker, Parker & Co.	303 0 0
	Maesyssfn	85	13 2 6	ditto	1115 12 6
	Mount Pleasant	7	12 13 6	Newton, Keates & Co.	92 14 6
	Hendre Ucha	28	13 10 6	ditto	378 14 0
	Bryngwyn	5	13 11 6	ditto	
	,,	5	13 11 6	Adam Eyton	283 0 0
	,,	10	14 14 6	Walker, Parker & Co.	
	Roman Gravels	20	13 8 6	ditto	288 10 0
,, 30.	Isle of Man Mining Co.	100	15 7 0	Panther Co.	1880 15 0
	,, (chats)	30	11 10 6	Newton, Keates & Co.	
	Bronfloyd	50	14 1 0	Sims, Willyams & Co.	702 10 0
Jan. 2.	Minera	100	13 10 6	Walker, Parker & Co.	
	,,	100	13 10 6	ditto	
	,,	95	13 10 6	ditto	
	,,	80	13 11 0	Mining Co. of Ireland	8304 5 0
	,,	80	13 13 6	Panther Co.	
	,,	80	13 11 6	ditto	
	,,	70	13 11 6	ditto	
	,,	9	11 2 6	Locke, Blackett, & Co.	
	,,	60	27 9 0	—	2153 5 0
,, 3.	Trelawny	50	10 2 6	—	
	,,	60	19 2 6	Treffry's Trustees	1147 10 0
	Chiverton	34	13 1 0	Walker, Parker & Co.	443 14 0
,, 5.	Isle of Islay Mine	55	12 19 0	Sims, Willyams & Co.	712 5 0
	East Logylas	65	15 18 0	Mining Co. of Ireland	1033 10 0
	Glogfach	170	13 2 6	Panther Co.	2231 5 0
	Cwmystwith	50	27 8 6	Stock & Co.	1335 0 0
,, 6.	Wheal Mary Ann	35	13 5 0	Michell & Co.	
	,,	30	15 3 6	Sims, Willyams & Co.	455 5 0
,, 7.	Llanfyrnach	35½	14 6 6	Walker, Parker & Co.	1155 8 3
,, 8.	Talargoch (Maesyrerwddu)	45	14 7 6	ditto	
	,, (Coetia Llys)	12	12 12 0	Newton, Keates & Co.	151 4 0
	Deep Level	12	12 16 0	ditto	153 12 0
	Brynford Hall	6	13 0 0	Adam Eyton	78 0 0
	Rhosesmor	30	13 12 6	Walker, Parker & Co.	406 15 0
	Parry's	60	14 6 6	Adam Eyton	858 10 0
	Bryn Gwiog	15	13 11 6	Walker, Parker & Co.	203 12 6
	Long Rake	5	12 0 0	ditto	60 0 0
	Merllyn	12	13 5 6	Newton, Keates & Co.	159 6 0
	Minera Union	24	13 0 6	ditto	312 12 0
	Llangynog United	10	14 0 6	ditto	140 5 0
	Llanerchyraur	20	13 8 0	Adam Eyton	268 0 0
	Roman Gravels	35	13 10 0	Stock & Co.	876 15 0
,, 9.	Wheal Frank Mills'	30	13 9 6	Michell & Son	
	,,	97¼	—	ditto	1434 3 0
	Cargoll	85	12 1 6	ditto	1026 7 6
,, 12.	South Exmouth	100	17 0 6	ditto	1702 10 0
	Great Laxey	184	13 7 0	Walker, Parker & Co.	2456 8 0
,, 16.	Dyliffe	35	13 6 6	Newton, Keates & Co.	466 7 6
	Dyfngwm	35	14 6 6	ditto	501 7 6
	Llanerchyraur	68	12 18 0	Newton, Keates & Co.	1766 6 0
,, 19.	Frongoch	68	13 1 6	Walker, Parker & Co.	
	,,	51	13 6 6	ditto	679 11 6
	Cefn Brwyno	95	16 0 0	Stock & Co.	1520 0 0
	East Darren	30	16 2 6	Treffry's Estate	1056 17 6
	Cwm Erfin	35	16 7 6	Newton, Keates & Co.	
	,,				

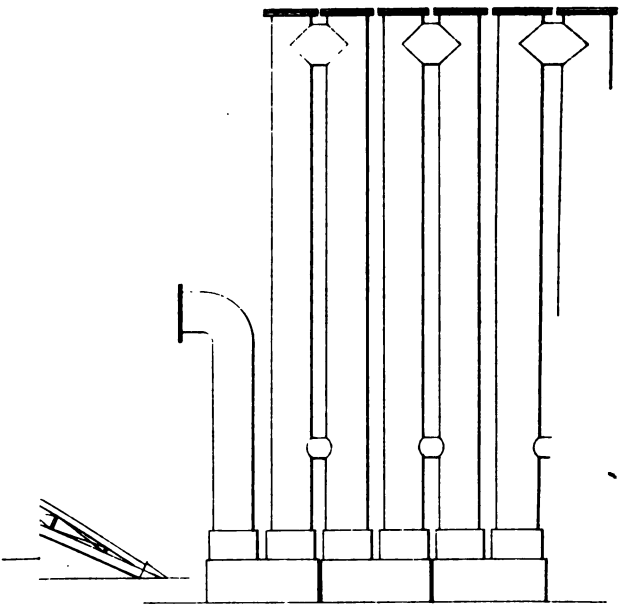

Fig. 8.

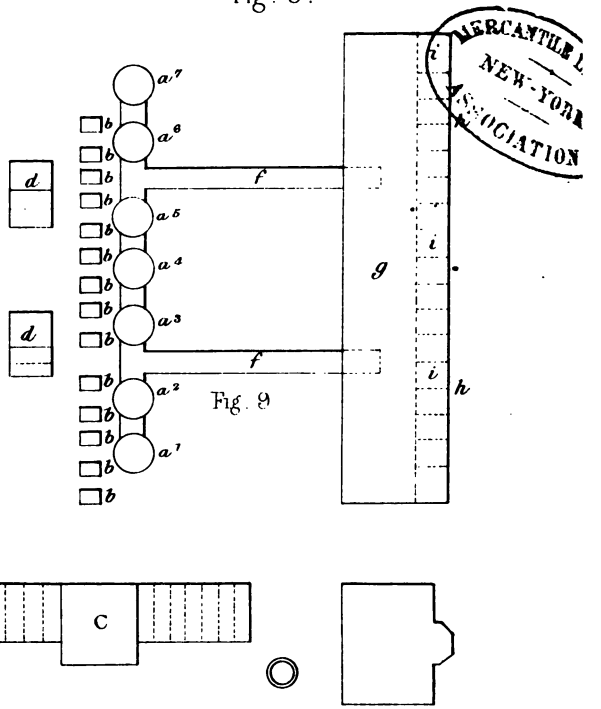

Fig. 9

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THE

MINING AND SMELTING MAGAZINE.

MARCH, 1863.

The Iron Manufacture of South Wales.

(Rails.)

By MM. Gruner and Lan.

(Abstracted from the *Annales des Mines*, 5th series, vol. xx, p. 515.)

(*Continued from page* 82.)

Situation and Condition of the Principal Iron Works of South Wales.*

In order to complete this historical sketch of the make of pig-iron in the South Wales district, we shall give some details of the condition and progressive development of its principal works. From them we shall see that, if their present position is precarious, they have yet had their periods of prosperity, from which certain iron-masters, although not very many, have been able to profit largely.

Most of the large Welsh works are situated on the northern outcrop of the Lower shales of the coal-basin, 15 or 20 miles from the sea, and generally not far from the heads of the transverse valleys which furrow this basin from north to south. We have said that in 1857 thirty-nine works with 173 blast-furnaces were in activity in the bituminous coal district, and ten with 34 furnaces in the anthracite district. We shall give a rapid glance at them, taking them from east to west. But it must first be remembered that the eastern works are connected with the port of Newport, those of the centre with Cardiff, and the western ones with Swansea, and that, in general, following these directions, canals and railways may be found everywhere.

Eastward, in Monmouthshire, on the southern borders of Breck-

* We extract the greater portion of these particulars from a manuscript note, which we owe to the courtesy of a technical engineer of the district, who has the management of several mines in Monmouthshire. Although these details refer to forges as well as blast-furnaces we yet think it well to give them here.

nockshire, the most considerable of the present companies is that of Ebbwvale. Its annual make is about 90,000 tons of rails and bar-iron, and it exports besides, from Newport, more than 100,000 tons of coal. This company has:—

19 blast-furnaces,
192 puddling-furnaces,
99 heating-furnaces, and
from 1,000 to 1,200 workmen's houses.

Its colliery leases comprise 7,500 acres of land, and the number of its effective workmen is 8,000.

But these are not all centred at one point, and it is only of late years that they have been amalgamated into one establishment, in consequence of the successive absorption of the original partnerships. The establishments of this company really comprise six separate works, without counting Pontypool, which, although a distinct firm, belongs equally to the principal shareholders in the Ebbwvale company. These six works are grouped round two centres: Ebbwvale, near the northern outcrop, and Pontypool, not far from the borders of the coal-basin.

The first group is wholly applied to the make of rails, and comprises the two neighbouring works of Victoria and Ebbwvale, at the head of the valley of Ebbwvale, and those of Sirhowy, two miles to the west in a parallel valley. The coal and iron mines which supply these works occupy all the surrounding land for an extent of 5,100 acres. These three establishments each include four furnaces, of which three are in blast, and some refineries. At Victoria and at Ebbwvale, there are, besides, 100 puddling furnaces, and in the latter of these works are two complete mill trains for rails. It is here, consequently, that the refining of the 80,000 tons of pig-iron, produced by nine blast-furnaces, and their transformation into 60,000 tons of rails, is completed. These three establishments were constructed by different proprietors, and were purchased by the present company at a relatively low price. The Ebbwvale works, the oldest of the three, date from the beginning of the century, while those of Victoria were only built about 1838. Contrary to the ordinary course of things Ebbwvale seems to have made the fortune of its founder and ruined his immediate successors. Sirhowy and Victoria have only prospered in the hands of the present company, owing to the relatively small capital invested in their purchase.

The Pontypool group is composed of the large works of Abersychan and the two smaller ones of Cwmbrân and Pentwyn. To these may be added the Pontypool works themselves, which, although managed separately, belong almost exclusively to the same proprietors. Abersychan comprises six furnaces, of which five are generally in blast, and one forge for rails of from 36 to 40 puddling furnaces. The annual make is from 35, to 40,000 tons of pig, giving from 20 to 25,000 tons of superior-quality rails, besides some iron of a high calibre. The works were established in 1826, by the British Iron Company, who lost in them the enormous sum of 400,000*l*. In 1852, they were purchased by the Ebbwvale Company, for the trifling sum of 8,500*l*., which was more than covered by the stock of manufactured products.

The neighbouring works of Pentwyn were scarcely more fortunate. They were established in 1825, and were a constant source of loss to their successive proprietors. They were composed of three blast-furnaces and a forge, which were sold separately: the furnaces, in 1853, passed into the hands of the Ebbwvale Company who never blew them in, but have since worked the mines belonging to them for the supply of Abersychan; the forge was bought by the Crawshay-Bailey family, by whom it has been abandoned as unprofitable. The third works above Pontypool are Cwmbrân, a small forge, constructed about 1840 specially for the production of merchant bars.

The Ebbwvale Company thus furnishes us with an example of this specialisation of make, which procures such great advantages for English mines. Sirhowy has only blast-furnaces; Victoria, blast-furnaces and puddling forges; Ebbwvale, blast-furnaces, puddling forges, and rolling mills for rails. These three works yield products of ordinary quality. The Abersychan works are complete in themselves, and make superior rails and large special bars; Cwmbrân produces ordinary merchant bars; and lastly Pontypool, which remains to be considered, superior special irons.

The Pontypool works date from the time of Queen Elizabeth. Until about 1800, tin-plates and iron-wire were made with great profit, from iron smelted by wood. About this period, in the place of the old wood blast-furnaces, four coke blast-furnaces were erected on the table-land of Blaendare, which overlooks the town. They persevered, however, in the making of special irons. Instead of rails and common bars, they still exclusively produce grey pig-metal, which is made into plates, superior bars, and tin-plates. Of these four furnaces, three are worked with cold air and without cinders; and all exclusively with coke. The annual production of Pontypool is 16,000 tons of pig, and about 10,000 tons of manufactured iron. The forge, properly so called, where the pig is refined, is separated into three divisions, ranged on the river which passes Pontypool. The refining and large heavy-plate forge is below the town, that for the rolling superior irons is above the town, and that for the make of tin-plates is between the others, near the town itself.

Above Pontypool, towards the head of the valley and at the north-east angle of the coal-basin, are the Blaenavon works, also producing superior-quality irons. They were constructed about 1780, and have, since 1837, passed into various hands, having been scarcely prosperous till recent times. At present they comprise five blast-furnaces, all with cold air and coke, and at the period of our visit the forge was being enlarged and must now include forty puddling furnaces, and a train of plate rolls on the system of Petin and Gaudet. Only one furnace is fed with cinders and produces white pig; this latter furnishes annually nearly 8,000 tons, while the other four only produce altogether from 18 to 20,000 tons of grey pig.

Between Blaenavon and Ebbwvale, in a parallel valley, are the united works of Blaina, Cwm-Celyn, and Coalbrookvale. Several iron-masters have been successively ruined here: at present they are carried on by Messrs. F. Levick and Co., and are only commercially

successful owing to the low price at which they were purchased. The make is specially rails; still, out of six furnaces, one is worked with cold air, and two or three others exclusively with coke, in order to produce good pig-metal, which is manufactured into merchant bars, and T and angle iron. The annual production of the works is about 40,000 tons of pig, giving 20,000 tons of rails, and from 6 to 8,000 tons of bar-iron.

At the heads of the valleys of Blaina and Ebbwvale we find the Nantyglo and Beaufort works, which made the colossal fortune of Sir Joseph Bailey. Being situated just at the outcrop of the coal and of the ores they had their raw materials at exceptionally low prices. At present circumstances are changed, for the outcrops are exhausted and the mines are at a distance from the works. Thus Nantyglo, comprising seven furnaces, is idle; and Beaufort, which includes eight furnaces, of which seven are in blast, as well as a large forge, has now entirely fallen off, and seems also on the point of being abandoned. The Beaufort pig-iron for a long time enjoyed a reputation for tenacity which it justly merited. It then resembled that of Pontypool and Blaenavon, and was produced in the same manner with cold air and coke, and without cinders. Now all is changed: the seven furnaces are worked with hot air; five produce white pig with the addition of cinders, and two furnish foundry-pig produced entirely from coal-measure ores; but this hot-air metal is black rather than grey, and is at the same time less tenacious and less pure than that of Pontypool and Blaenavon. The production of the seven furnaces is about 40,000 tons. Rails and bar-iron are manufactured in the forge.

To the west of Ebbwvale, at some 100 yards from Sirhowy and upon the opposite flank of the same valley, we find the Tredegar works, the most important, after Ebbwvale, of the works producing rails of Monmouthshire—and one whose economical condition is most favourable. The establishment dates from the year 1824. The forge, which was reconstructed in 1833, is remarkable for the symmetrical arrangement of its various parts: the puddling department consists of a large building in which four squeezers and four roughing rolls are ranged in a line. From this principal building four less elevated ones branch off at right angles, facing respectively the four squeezers, each comprising 20 puddling furnaces in two parallel rows of ten. Thus the entire works include 80 puddling furnaces, and close by these are nine large blast-furnaces. At the period of our visit six blast-furnaces were working with hot air, producing ordinary white pig-metal for rails; a seventh, working with cold air yielded grey pig. All were provided with a cone-shaped stopper for collecting the gases, and regularly distributing the charge. The works produce from 60 to 65,000 tons of pig-iron, and about 40,000 tons of rails.

We may mention for the sake of reference, the two unimportant works of Golynos and Varteg, situated between Abersychan and Blaenavon. They have given but little profit to their proprietors or successive tenants, and one of them (Golynos) is about to be abandoned in consequence.

Lastly we may also refer to Clydach, in Brecknockshire, as the

last works of the eastern district. They are near Beaufort, in the valley of Abergavenny, and are situated under similar conditions as regards raw materials. Notwithstanding this they have not prospered like their neighbour. They were established in 1780, and at present comprise four furnaces, of which three are in blast, and a forge for rails and bars.

If now we direct our attention to the west we shall find, three miles from Tredegar, the Rhymney works, on the borders of Monmouthshire, and a little further on those of Bute in Glamorganshire, both belonging to the Rhymney Iron Company. The conditions and circumstances of these two establishments are very similar to those of Tredegar. There are nine blast-furnaces and about 80 puddling furnaces, and the make is almost exclusively rails.

In Glamorganshire the principal works are grouped round the small town of Merthyr-Tydvil, and, like those of Monmouthshire, are situated on the northern outcrop of the lower shales. They are: Dowlais and Penydarren to the north, Cyfarthfa and Ynisfach to the west, and Plymouth-works to the south-east. A canal and railway connect them with the port of Cardiff, distant from 20 to 25 miles.

Dowlais, the largest of these establishments, was founded in 1790. At first it included only two blast-furnaces and one small forge. The first years were attended with difficulties, but under the able and energetic management of the late Sir John Guest, sole proprietor, the works were gradually developed, and at last during the railway period gave enormous profits. Doubtless the cause of this brilliant success may be traced principally, as in the cases of Beaufort and Nantyglo, to the exceptional abundance of the raw materials, but second to this it is certainly due to the perfect unity of management and the gradual development of the enterprise, which was pushed on without ceasing from year to year, from 1790 until 1845; while other works, under apparently identical conditions, have not been able to maintain their position, principally because they sprung up too suddenly at the beginning, being established on too large a scale.

Dowlais has comprised since 1845:—

18 blast-furnaces,
8 refineries,
145 puddling-furnaces, and
87 heating-furnaces.

This establishment contains a monster blowing machine, and the largest blast-furnace in England (see *Mining and Smelting Magazine*, vol. i, Plate III, Fig. 10). A powerful train of rolls for the largest special bars has just been installed in a new forge: we shall refer to them elsewhere. The colliery leases of the Dowlais works comprise upwards of 6,000 acres, and the number of its workmen is from 8 to 9,000. Sixteen furnaces are generally in blast, and the average make per week is from 13 to 1,500 tons of rails, and from 4 to 600 tons of various manufactured iron. Per year it is about 135,000 tons of pig-iron, and from 90 to 100,000 tons of rails and bars. The charges of the Dowlais furnaces are very variable. Only

one is charged with coal-measure ores and produces grey foundry-pig, almost all the others being worked with the addition of cinders and producing white pig, more or less granular; and sometimes one of these is for a certain time worked almost entirely with forge cinders. All the furnaces are blown with hot air and the greater part are fed with raw coal; some only are provided with apparatus for utilising the gases.

The Penydarren works are situated below Dowlais, close to Merthyr-Tydvil, and were also established towards the end of the last century, but they have never given results comparable to those of their neighbour. Of late years they must even have been a source of loss, for we found them completely at a stand-still. They have recently given up all their mines to Dowlais, and seemingly do not intend to take them again. They include seven blast-furnaces and one forge for rails of a proportionate extent.

In the opposite suburb of Merthyr-Tydvil are the Ynisfach works, comprising four blast-furnaces; and above, in the principal valley, those of Cyfarthfa, including seven blast-furnaces and one large forge of 80 puddling furnaces—possessing as motive power two water-wheels of 36′ diameter and from 8′ to 9′ breast. The canal which connects Merthyr-Tydvil with Cardiff commences at these works, and the major portion of it belongs to the Crawshay family, the wealthy owners of the two works in question. Like Sir John Guest at Dowlais, the late Mr. W. Crawshay, the father of the present owners, realised an immense fortune from these works. The Cyfarthfa and Ynisfach works are in excellent condition, contrasting with the dilapidated and disordered appearance of many of the Welsh works. The make is also carefully attended to. The rails are of superior quality and the other irons are held in general estimation. To produce these results all the furnaces are fed with coke (carbonised in the open air from large coal), and several are blown with cold air. The limestone is charged in a caustic state, but the production of granular white pig is avoided. The ordinary product is white lamellar or mottled, sometimes grey, and almost all the pig is refined. From this cause the cost-price is higher than that of other works; but owing to the nature of the pig-metal, rails may be obtained, as at Cyfarthfa, at one heating, and a notable proportion of bar-iron of pretty good quality is also made. The annual production of Cyfarthfa and Ynisfach is about 60,000 tons of pig-iron, and 40,000 tons of rails and bars.

The Plymouth-works are situated two miles below Cyfarthfa, on the borders of the Cardiff canal. They include five blast-furnaces, and a very well-situated forge. As at Cyfarthfa they seek to furnish superior products and, owing to the higher prices they consequently obtain, their affairs seem to be in a prosperous condition. The production of pig-iron may be as high as 30,000 tons, and that of rails and bars from 20 to 21,000 tons.

To the west of Merthyr-Tydvil, Glamorganshire includes one more important establishment for the make of rails, belonging to the Aberdare Iron Company. It is composed of the two contiguous works of Aberdare and Llaydard, and the Taff Vale forge (for rails) near Newbridge. These works include seven furnaces, six in blast, and 78

puddling furnaces. As at Dowlais, their object is to produce a large quantity of ordinary quality, and, like the Ebbwvale company, they export coal from Cardiff. The number of workmen is 3,500 and the annual production from 50 to 55,000 tons of pig-iron, yielding from 35 to 40,000 tons of rails.

In the northern part of the coal-basin we have still to mention the Hirwain works, in Brecknockshire, now abandoned; and the two works of Gadlys and Aberamman, the former including four, the latter three blast-furnces, to which have just been added a proportionate number of puddling and heating furnaces. Gadlys produces besides, specially, cold-air grey pig, of superior quality, as shown in the table of selling prices of Welsh pig (see *Mining and Smelting Magazine*, vol. iii, No. 14, page 81).

Besides the works we have mentioned, furnaces and forges have been erected at various periods in the southern part of the coal-basin, but have never attained any great importance, being badly placed as regards raw materials. Many have long been abandoned, and almost all have been the ruin of those who started them. We must however except the Pentyrch works, in the Taff Vale, where two blast-furnaces furnish good grey pig to the tin-plate works of the neighbourhood.

If now we turn to the anthracite district we shall first find in the Vale of Neath, the Venault works in ruins, and those of Abernant with but one furnace in blast out of three; then, between Neath and the Vale of Swansea, the two smaller works of Banwen and Onllwyn, often idle; lastly in the Vale of Swansea itself, Yniscedwin, Abercrave, and Ystalyfera, the only considerable and prosperous works of the district.

The Yniscedwin are the oldest works in the country: the furnaces have been worked successively with wood and coke, and only during the last twenty years with anthracite. They include six furnaces, of which five are generally in blast. They have no forge but sell all their pig-iron, that is 15,000 tons, to the tin-plate works, and 2,500 tons for foundry-pig. Abercrave was constructed in 1826, and only comprises one blast-furnace, under conditions differing little from those of Yniscedwin.

Lastly, Ystalyfera, the only complete establishment of the district, is composed of eleven furnaces, seven or eight in blast, an immense forge, and a tin-plate works. Its annual production is 25,000 tons of pig-iron, partly grey, partly white, which is almost all completely refined in the works. We have seen, from what has gone before, that white pig is produced by an addition of cinders and is made principally into rails, while the grey pig is refined for plates and tin-plates, using, according to the quality desired, exclusively charcoal, or a mixture of coke and charcoal. The Ystalyfera works are distinguished from all the other Welsh works by the complete utilisation of the gases.

To the west of the Vale of Swansea, in Carmarthenshire, there are three or four more works but all unimportant, for there is only one furnace in blast among them all.

To sum up, out of 34 furnaces in the anthracite district, 14 or 15 only have been in blast since 1858. In general almost all the works are unfavourably situated as regards raw materials and means of communication.

To conclude, we may remark that in the Forest of Dean, to the east of South Wales, the conditions do not appear to be very favourable, for out of five works two only, and out of six blast-furnaces four only were at work in 1858. The only prosperous works are those of Cinderford, where three furnaces in blast furnish, like Yniscedwin, hot-air grey pig for tin-plates.

Note on the Manufacture of Antimony.

METALLIC Antimony is prepared principally from the sulphide, which is largely imported from the Island of Borneo. The oxide of antimony, although also imported in considerable quantities, is very sparingly used in the production of the metal: when used alone, or largely mixed with the sulphide, it proves very destructive to the crucibles; but a small quantity of it very much improves the quality and appearance of the metal as compared with that produced from the sulphide alone. A patent has lately been granted for the use of oxide of antimony as a substitute for white lead as a pigment.

The reduction of antimony is a very simple process, and the heat required is not very great, the metal itself melting at a temperature somewhat below 1,000° Fahrenheit.

A very important point in the manufacture of antimony is to obtain good crucibles. In most instances we believe these are manufactured by the smelters themselves, those obtained from the various crucible makers being too expensive, and not answering the purpose for which they are required any better than those made by the smelters. We do not, however, believe that the crucibles manufactured by the antimony smelters would be equal to those made for instance by the Plumbago Crucible Company at Battersea for standing high temperatures, such as melting the precious metals; but where a comparatively low temperature is required, and the penetrating power of the metal great, then they answer equally well. The crucibles are composed of a mixture (which varies in different works) of fire-clay, plumbago, and old crucibles ground up. It is of great importance that all these should be quite free from foreign matters, such as small pieces of wood or hairs, before being made into pots.

The manufacture of antimony may be divided into three distinct operations, as follows:

1st. Melting the ore with metallic iron, to obtain crude antimony, which operation is termed *Singling*.

2nd. Remelting the product from the first operation (or the *Singles*) to obtain *Bowl Metal*, which operation is termed *Doubling*.

3rd. *Refining*, or *Frenching*.

1. *Singling.*—The ore is first broken into moderately sized pieces, about half the size of an egg: if too small, the charge takes a much longer time to melt. About 40 lbs. of the ore thus broken is weighted off, and introduced through an iron funnel into a crucible, previously brought to a red-heat. There is now thrown over this a portion of slag from the second operation, which, besides some antimony, also contains a small portion of alkali that aids in forming a slag with the earthy part of the ore; and on the top of all is put about 20 lbs. of old iron, beaten into the shape of a cone.* Of course the quantity of iron will vary according to the quality of the ore smelted; in the case given we are presuming the ore to contain from 50 to 55 per cent. of antimony.

The cover of the fire is now drawn on, and the whole gradually melted. From time to time, as the melting goes on, the pieces of iron are pressed into the interior of the mass, where they become rapidly acted upon and converted into sulphide, whilst the antimony is reduced to the metallic state. When the whole has become melted—which ought to be in from 1½ to 2 hours—the crucible is removed from the fire by means of a large pair of tongs (the jaws of which exactly fit round the outside of the crucible), and its contents poured into a large cone-shaped cast iron mould. The crucible is at once returned to the fire, and a fresh charge added and proceeded with as before.

When the charge in the mould is quite set, the latter is turned over and struck with a hammer, when the charge falls out. The button of crude antimony is found at the bottom, and is very easily separated from the sulphide of iron by a slight tap with a hammer. One man ought to smelt from 10 to 11 cwts. of ore in twelve hours.

2. *Doubling.*—The buttons of antimony from the last operation are broken for the purpose of inspecting the grain of the metal, by which it is known whether too much or not enough iron had been used in the smelting. It is advisable to err in adding a little too much than not to have enough, as the addition of a small portion of raw ore in the Doubling process will take it up. The Singles are sorted according to the judgment of the workmen, in such a manner that those containing an excess of sulphur shall be melted with those containing an excess of iron. From 70 to 80 lbs. of the Singles thus sorted are introduced into a crucible with a little salt cake, and melted; which will not take more than an hour or an hour and a-half, including charging and pouring. When thoroughly melted, it is poured into a cast-iron *Bowl;* whence it has received the name of Bowl metal, in which state it is often sold, for various purposes. When quite set, the metal is removed, and whatever slag adheres to it cleaned off. When quite clean it is broken with a blow from a sledge, and the fracture carefully examined, for the purpose of classifying it so as to obtain a good mixture for the next operation. One man in twelve hours ought to be able to make easily from 15 to 17 cwt. of Bowl metal.

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* The iron commonly used for this purpose is old tinned iron kettles, saucepans, and the like. This description of iron suits best, as it is thin and easily acted upon: the only object in beating these pieces into a cone is for convenience.

3. *Refining.*—From 60 to 70 lbs. of the Bowl metal is introduced into a red hot crucible, with from 1 to 2 lbs. of American potash (according to the quality of both metal and potash), and 10 lbs. of slag obtained from a previous charge of French metal. When the charge is completely melted, which will take about three-quarters of an hour, the workman stirs it with an iron bar; on withdrawing this, he brings with it a portion of the slag, from the colour and general appearance of which he judges when the operation is completed. When this is arrived at, the slag should be perfectly smooth, and of a deep black colour. The contents of the crucible are then poured into rectangular, or sometimes round, moulds. It is of the utmost importance that, in this stage, the surface of the metal should be entirely covered with the slag, otherwise the necessary crystallization will not take place. For the same reason it is also necessary that the moulds should not be shaken while the metal is cooling. When great care has been taken in this operation, the surface of the metal has a very beautiful, fern-like appearance. It requires a good deal of experience on the part of the workmen to be able to make good Star antimony. One man ought to make in twelve hours about the same quantity of Star as of Bowl metal, viz., from 15 to 17 cwt.

The St. Ives and Lelant Tin-Mining District, Cornwall.

THE Peninsula of Penwith, which forms the extreme west of Cornwall, comprises a tract of country stretching in a south-westerly direction for a length of about 14 miles, with an average width of 6 or 7, from the Hayle estuary to the Land's End. On the north, west and south it is bounded by the sea; and on the east by the line of the low isthmus that extends from the head of the Hayle estuary to Mounts Bay a little west of Marazion—a line which also approximately forms the boundary between the parishes of Lelant and Ludgvan on the west, and those of St. Erth and St. Hilary on the east.*

The geological structure of this peninsula is as distinct as its geographical conformation, for it is the seat of the most western of the five great granite ranges which form at once the most distinctive geographical and geological features of Cornwall and South Devon. Fully nine-tenths of its surface consists of granite; which, however, is skirted, throughout about two-thirds of the peninsula, by a band composed of clay slate or hornblendic schists.

As a mining country its product is essentially tin. On its south-east border, in the parish of Ludgvan, extensive copper mines have been worked; but these are on a western continuation of the lodes of the Marazion district, and are found to decrease in value for copper as they approach the granite. In St. Just, also, highly pro-

* The peninsula comprises the following fourteen parishes: Ludgvan, Lelant, St. Ives, Towednack, Zennor, Madron, Gulval, St. Paul, Sancreed, St. Buryan, St. Levan, Sennen, St. Just, and Morvah.

ductive copper mines have been worked, at Botallack and Levant, in the hornblendic schist, which here forms a narrow band between the granite and the sea; but the lodes, or "guides," as they are locally called, which produce this copper are so exceptional in their character compared with those of the rest of Cornwall that they require a special classification in themselves. The granite, as stated, forms the great proportion of the surface, and the rock is exclusively stanniferous.

It is, however, by no means equally so throughout. With the exception of the very curious and ancient mine of Ding Dong, and one or two others of less note, the heart of the granite is economically unproductive of tin; the rich mines being found in a zone skirting the junction of this rock with the killas. Not that the granite bordering the line of junction is by any means invariably productive; indeed scarcely more than a quarter of it is found to be so, and this portion may conveniently be divided into two districts—that of St. Just, at the western extremity of the peninsula, and that of St. Ives and Lelant, at the north-eastern extremity. We propose on the present occasion dealing with the latter district.

The St. Ives and Lelant district includes the larger proportion of the three parishes of St. Ives, Lelant, and Towednack. Its greatest length in a north-west line is about 4 miles, and its greatest width, measured at right angles to this, from 2½ to 3 miles. It comprises, at present at work, the important mines of St. Ives Consols, Providence Mines, Wheal Margaret, Wheal Reeth, Wheal Mary, Wheal Kitty, and Rosewall and Ransom United; with nearly a dozen others—some fairly progressive mines, and others mere embryo trials.

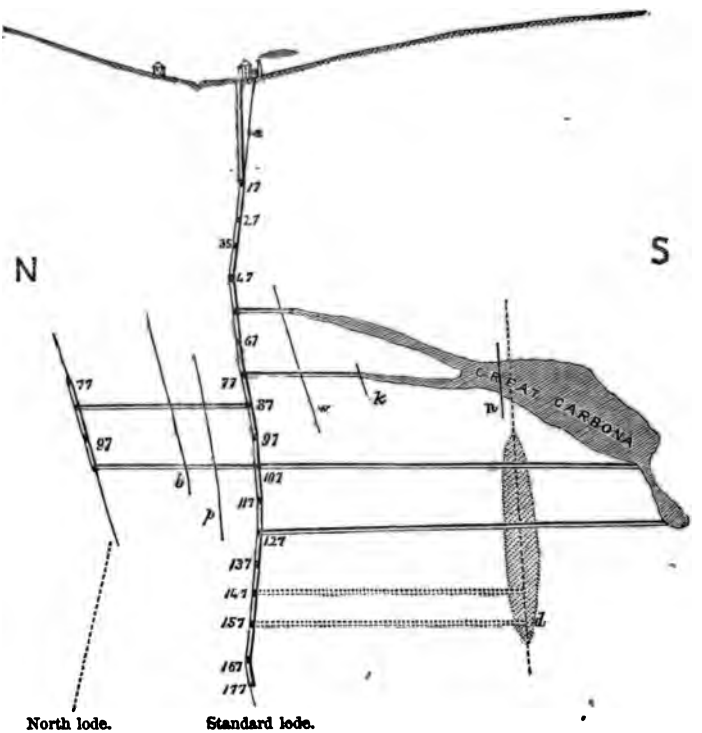
ST. IVES CONSOLS may probably be fairly taken as altogether the most important and interesting mine in the district. The original workings by the "old men" are lost in obscurity, but the present operations were commenced in 1818, and, curious to say, were set about merely for electioneering purposes. Before the Reform Bill the borough of St. Ives (which included the whole parish), returned, two members. Under such circumstances a mine affording the means of giving considerable employment and distributing large sums of money, would naturally possess considerable influence in returning the representatives. In former days mining was largely used throughout West Cornwall as a means of political influence; and even at the present day instances of this are not wholly unknown. At any rate St. Ives Consols was set to work for electioneering purposes, with very little intention of mining *bonâ fide;* and the successful result is a curious instance of how the intrinsic soundness of an enterprise may carry it through the most unpromising circumstances. The original number of shares was 47, which has been successively increased to 94, 470, and 940, the present number.

St. Ives Consols is a granite mine, although not far from the junction of that rock with the hornblendic schists and greenstone, which come in immediately to the east, and indeed overlie the granite in some of the eastern shafts. It lies immediately to the west of the town, and the principal lode traverses the bottom of the

rather steep valley through which passes the mountain stream tha falls into the sea at St. Ives. This is called the Standard lode, and bears very nearly magnetic east and west—a little to the S. of W.—and goes down vertically on the whole. The accompanying transverse section, Fig. 11, shows the position of this lode.

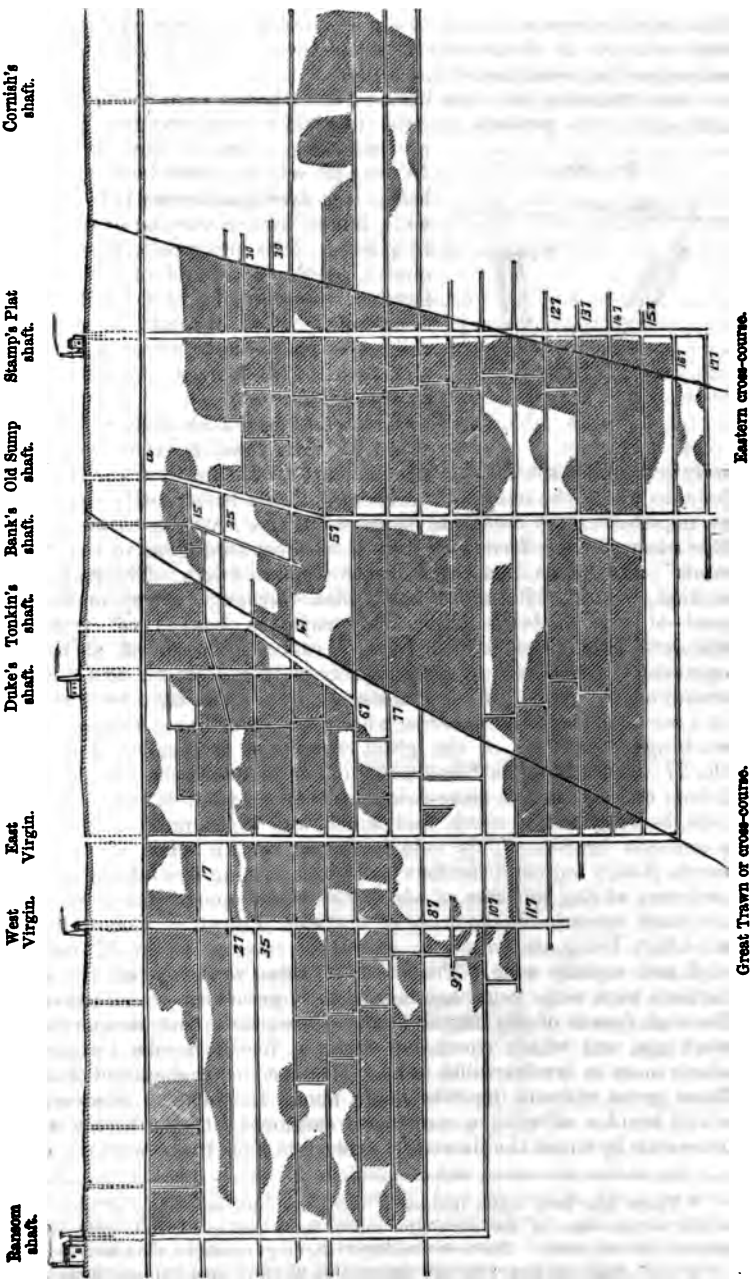
FIG. 11.

TRANSVERSE SECTION AT ST. IVES CONSOLS. Scale: 60 fathoms to 1 inch.



The Standard lode has been worked to the depth of 177 fathoms below adit, which is 20 fathoms from grass, showing a total depth from surface of nearly 200 fathoms. The lode in the bottom level is hard and unproductive, so that little has been done at that depth, and the bottoms have been abandoned for upwards of ten years. The section, Fig. 12, on the following page, shows the workings on this lode. The western boundary, between St. Ives Consols and Rosewall and Ransom, is 56 fathoms west of Ransom shaft.

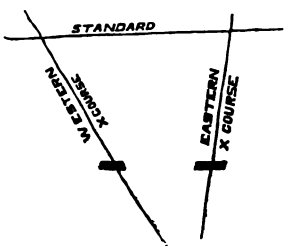
As shown by this section the standard is intersected by two principal cross-courses—or "trawns," as they are called in the district—made up principally of decomposed granitic matter, both underlying west, but the eastern one less than the other. They cross the lode about 120 fathoms apart; but as the western trawn


Cornish's shaft.
Stamp's Flat shaft.
Old Sump shaft.
Bank's shaft.
Tonkin's shaft.
Duke's shaft.
East Virgin.
West Virgin.
Bassom shaft.
Eastern cross-course.
Great Trawn or cross-course.

bears about S. 40° E., while the eastern one bears about S. 5° W., they rapidly approach each other going south—there being in fact but an angle of about 45° between them. This is shown by the accompanying rough sketch. Fig. 13.

This Standard lode has been on the whole a very productive one, although at the present moment its yield is only moderate, probably not exceeding 4 tons of tin per month. In no part was it a very large lode, probably not averaging more than 2½ feet wide, but of course varying considerably in places. It is principally made up of quartz, peach (a mineral of the chlorite family), decomposed granitic matter, and a large proportion of schorl in many localities — particularly where the tin is abundant. It is heaved about 4 fathoms by the great trawn.

Fig. 13.



The most remarkable feature, however, about St. Ives Consols is the extraordinary deposits of tin that have been found to the south of the standard lode, to which the name of "carbonas*" has been locally given. It is impossible in a moderate compass to give a very accurate idea of this stanniferous formation, but it is most analogous to the "pipe veins" and "flats" of the limestone lead districts. The transverse section, Fig. 11, will afford some idea—although a very inadequate one—of the mode in which the carbonas branch off from the standard lode. One, called Lawry's carbona, shoots off at the 57, opposite Duke's shaft, dipping rapidly as it goes south, and forming stanniferous "flats" of various dimensions, which have been worked in a series of irregular caverns, wholly unlike ordinary Cornish mine workings. Another, or the great carbona as it is called, goes off at the 77. At about 40 fathoms south of the standard the level, which is driven on the western cross-course, intersects what is called Kemp's lode, bearing nearly north and south, and which really seems to be a carbona branch. This lode is driven on for some way until it meets Noal's lode and the flats and pipes coming down from Lawry's carbona; at the junction of which the whole opened out into one of the most remarkable deposits of tin ever known in Cornwall—the workings being excavated in enormous caverns 10 or 12 fathoms high and equally wide. The whole of these workings on the great carbona were some years ago ruined by a great fire, which consumed the stull (made of the largest timber procurable) that supported the workings, and which continued burning for six weeks, leaving the whole mass in irretrievable ruin. It must be understood that all these great carbona deposits made about the western cross-course, which besides afforded a convenient easement for the driving of the cross-cuts by which the tin-stuff was brought back to the working shafts

* There has been some discussion respecting the etymology of this word, which antiquarians of the old Celtic school have pretended to identify with an ancient Cornish word. There seems, however, no grounds for this, and the word is probably really an unaccountable corruption of some slang mining phrase.

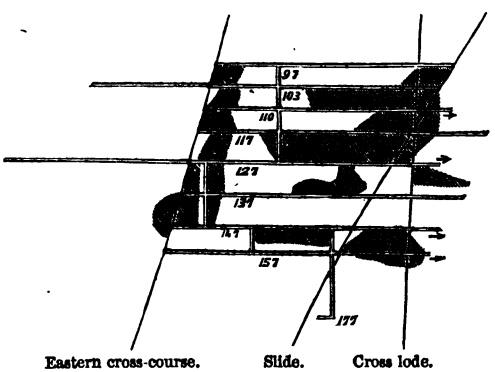
on the standard lode. It is noticeable that all these carbonas form to the south of the standard, and that when they near that lode they are generally small; indeed, looking at the matter in a large view, they seem to have been developed on an extensive scale by the contact of a series of approximately east and west lodes or branches —which range about 80 fathoms south of the standard—with the converging cross-courses. The case of Daniel's lode, about the eastern cross-course (to which we shall refer further on), also supports this idea, which will probably be made more intelligible by a glance at the sketch given at Fig. 13, where these east and west veins are shown south of the standard, in contact with the cross-courses.

The beginning of a carbona is at present seen in a level driving south-east at the 67, now in about 12 fathoms from the standard. In the end there is a pipe reaching about half way up, surrounded entirely by granite, and made up principally of schorl with sufficient tin to make the work worth 6*s*. per barrow. The carbonas where productive are essentially characterised by a great development of schorl. Besides Kemp's lode and the carbona branches another, called William's lode, has been met with south of the standard, but this is not of much importance.

The principal workings to the south at present—and indeed they are the principal workings in the mine—are on Daniel's lode, about the eastern cross-course. This lode, which bears about E. 5° S., is about 80 fathoms south of the standard at the 127, being in fact on the same run as Noal's lode and the branches that seem to have developed the great carbona to its largest extent (see sketch Fig. 13). The workings on Daniel's lode are shown by the accompanying section, Fig. 14; but this really gives a very inadequate idea of them,

FIG. 14.

SECTION ON THE LINE OF DANIEL'S LODE. Scale: 60 fathoms to 1 inch.



because their most striking feature is the immense width of the workings, often reaching upwards of 40 feet, although, when unproductive, the lode is scarcely traceable. The extent and position of the workings on this lode are attempted to some extent to be shown by the dotted lines and space in the transverse section Fig. 11.

It will be seen by the section that the principal tin ground has made east of the eastern cross-course, which heaves the lode 8 fathoms. The lode has attained its greatest width about the slide and cross lode shown in the section. The former is about 12 inches wide, made up of granitic matter; and the latter has been opened on to some extent and produced some amount of tin. In the ground extending from the 97 to the 127, in the space marked in the section as worked away, there are really at present upwards of a dozen pitches at work, and altogether Daniel's lode is now producing about half the tin raised in the mine. It has been in operation about fifteen years and is worked by cross-cuts from the standard, driven on the eastern cross-course. As the lode is not only very large but also very variable, the conditions of the tin ground are continually changing: as much as 24 tons of tin have been raised from two pitches in one month, and at the back of the 127 one pare of men have been working continuously at the same pitch for nearly four years. Some of the ends which are shown in Fig. 14 as driving are opening out valuable ground; but in a lode of this great size and variable character a level really tells very little. The average value of the work in Daniel's lode is good, ranging from 6*s.* to 7*s.* per barrow.

To the north of the standard three lodes have been intersected—Perran lode, the North branch, and the North lode. The two former are unimportant, but the latter, which has been cross-cut on the great cross-course from the standard at the 87 and 107, and has also been opened upon by intermediate levels at the 77 and 97, is a promising lode, about 2½ feet wide. It was discovered many years ago in the 107 cross-cut, but has only been opened on, and the 87 cross-cut driven, within the last two years. The only other lode that requires mentioning is the Caunter, which branches off from the standard at the Stamps Plat shaft, at the 107, with a bearing E. 25° S.

As is the case with almost all granite mines, the water at St. Ives Consols is only trifling. On the Old Sump shaft there is a 30″ pumping engine, which has been at work for forty-five years, and which has still a wooden beam—one of the very few now left in the county. This engine raises the water from the 177 to the 107 by three 6½″ lifts. At the 107 the water goes back to Ransom shaft, on which there is a 50″ engine. This raises the water by three 8″ lifts to the adit, and also raises for the purpose of condensing, &c., a still larger column by a 12″ pole from the adit to the surface.

There are two whim engines, a 22″ and a 20″. Half the tin-stuff broken in the mine is drawn through the Stamps Plat shaft, a quarter from East Virgin, and the remaining quarter from Old Sump, West Virgin, and Ransom shafts, but principally Old Sump. All the stuff is drawn by kibbles.

There is one 26″ stamping engine, working forty-eight heads, and thirty other heads are worked by four waterwheels. The weight of the heads varies from 3 to 3½ cwts., and they all stamp with grates. The present average monthly return of tin is about 23 tons, which is produced from about 4,600 barrows of work—200 barrows of work on an average yielding one ton of tin.

This "barrow" by which all tin-stuff is estimated in the Lelant

and adjoining districts equals 22 gallons, old ale measure. Of course the weight of the work contained in one of these barrows varies with its nature—the richer the work the greater being the specific gravity; but, on a rough average, six barrows may be estimated to weigh one ton, which gives the approximate weight of the barrow as 3 cwt. 1½ qrs. The assay of the work in a sack is made on half a noggin, old wine measure; and, as a practical fact, it is found that, taking tin at a standard of 40*l.*, each grain produced from this half noggin shows tin to the value of 1*d.* in the barrow, and, consequently, 1 dwt., tin to the value of 2*s.* Of course a mode of calculation such as this is barbarous in the extreme, but tributers are so accustomed to it, and are so suspicious about the introduction of the system of trying by weight with which they are unfamiliar, that it is very difficult to alter. As under this system tin is always estimated at 40*l.* per ton, the barrow is really worth at present prices of black tin (say 60*l.* per ton) one-half more than its nominal value. Thus, work stated to be worth 6*s.* a barrow is really worth 9*s.* at present prices of tin; and as six barrows make a ton, the work would be worth 54*s.* per ton. From what has been stated our readers will thus understand that each dwt. of produce shows a value, at the nominal 40*l.* standard, of 2*s.*, and each grain of 1*d. per barrow.* Multiplying this by six, we get the value *per ton*, at the 40*l.* standard; to which must be added any proportionate increase beyond this price—at present prices one-half. Thus if a sample tries 2 dwts. 6 grs. its nominal value will be 4*s.* 6*d.* per barrow, and 27*s.* per ton or, adding one-half, 40*s.* 6*d.* per ton.

At St. Ives Consols, as two hundred barrows of work yield on an average 1 ton of black tin, the value, at the 40*l.* standard, will be 4*s.* per barrow, or 24*s.* per ton. Adding one-half, we find the real value to be 36*s.* per ton—a high average, fully one-third, if not nearly one-half, greater than that of the county. The quality of the tin is "superior common."

This mine, as already stated, was commenced in 1818. The first manager was Captain Richard Hodge, who was succeeded successively by Captains John Gluyas, Holman, and George Davey. Captain Nicholas Tredinnick, who was subsequently for many years a manager of East Crofty, next followed, and he was succeeded by Captain Thomas Treweeke (at present manager of Wheal Margaret), who had the direction of St. Ives Consols for twenty years. On his leaving the management passed to the late Captain Edward Bawden, who was succeeded, about three years ago, by Captain John Nancarrow, the present manager. The present underground agents are Captain Martin George and Richard Martin; the dressing Agent is Captain Wilkins.

The first purser was Mr. Robert Bennett, who was succeeded by Mr. Edwin Ley, now of Jetwells, near Camelford. Mr. J. N. R. Millett next occupied the pursership for some time, but was succeeded again by Mr. Ley. The late Mr. William Darke next followed, and since his death, within the last two years, Captain Phillip Aplin has filled that position. The oldest officer in the mine, however, is the accountant, Mr. John Vivian, who has occupied that post for thirty-eight years.

The principal shareholder in the mine is the Earl of Lauderdale, who, by himself and his brother, the late earl, has held his interest without any change for upward of twenty years.

The mine commenced dividing profits in 1827, since which year there has been 104 dividends, amounting in the total to 107,418*l.* 10*s.*, as shown by the following particulars, for which we are indebted to Mr. John Vivian.

St. Ives Consols Dividends.

	£
1827.	
June	470
September	470
December	705
1828.	
March	940
June	940
September	940
December	940
1829.	
March	470
1830.	
June	470
September	705
December	1175
1831.	
March	1410
June	2350
1832.	
March	940
June	1645
September	1410
December	1175
1833.	
March	705
September	1410
December	705
1834.	
March	940
June	940
September	940
December	940
1835.	
March	940
June	940
September	940
December	940
1836.	
March	1645
June	1880
September	470
December	705
1837.	
March	940
September	705
December	940
1838.	
March	1410
June	1410
September	1645
December	1880
1839.	
March	1974
June	1410
September	940
December	940
1840.	
March	1410
June	1410
September	1645
December	1880
1841.	
March	2115
June	1410
September	1410
December	940
1842.	
March	470
June	470
1843.	
March	470
June	470
December	470
1844.	
June	470
September	940
December	470
1845.	
March	940
June	940
September	940
December	940
1846.	
March	1880
June	940
September	940
1848.	
December	470
1850.	
September	282
December	376
1851.	
March	470
June	376
December	470
1852.	
March	650
June	376
September	282
December	470
1853.	
March	282
June	282
September	376
December	752
1856.	
March	752
June	470
September	658
December	752
1857.	
March	658
September	470
1858.	
March	705
June	705
September	1175
December	2820
1859.	
March	3055
June	3055
September	2820
December	2820
1860.	
March	2350
June	2350
September	1645
December	940
1861.	
March	705
June	352 10
September	470
1862.	
March	470
June	470
September	470
	107,418 10

The particulars of the early returns of the mine are lost, but Mr. Vivian has kindly favoured us with the following statement of the quantities of black tin sold, and the amounts received for it, during the last twenty-eight years. A statement of the kind, extending over so many years, is one of great value, especially taken in connection with the particulars of dividends given above; and we are sure our readers will join with us in thanking Mr. Vivian for the trouble he has taken in extracting it from the books.

St. Ives Consols: Black Tin Sold.

	Tons	cwt.	qr.	lb.	Amount. £	s.	d.
1835.							
March..	84	8	1	20	4,004	16	0
June ..	80	17	1	27	3,987	6	2
Sept. ..	83	9	2	2	4,195	12	10
Dec. ..	77	14	2	27	4,358	14	2
1836.							
March..	84	5	2	3	5,160	11	1
June ..	83	13	3	15	5,974	5	11
Sept. ..	83	7	1	8	4,821	8	7
Dec. ..	85	5	3	10	4,174	2	10
1837.							
March..	89	11	2	25	4,267	9	0
June ..	101	3	3	3	4,021	2	7
Sept. ..	106	7	3	2	4,913	2	2
Dec. ..	100	16	2	22	4,625	7	3
1838.							
March..	107	9	3	22	5,096	2	10
June ..	114	14	0	6	4,881	3	6
Sept. ..	113	7	1	17	5,197	16	9
Dec. ..	117	11	1	10	5,797	19	6
1839.							
March..	140	11	2	4	6,432	6	2
June ..	120	7	2	0	5,249	10	9
Sept. ..	122	2	1	16	5,229	2	0
Dec. ..	119	15	0	7	5,189	0	0
1840.							
March..	128	9	3	6	5,661	14	9
June & Sept.	277	6	3	7	11,903	7	11
Dec. ..	146	8	0	13	6,020	17	5
1841.							
March..	159	12	2	4	6,980	6	6
June ..	143	9	3	26	5,764	5	6
Sept. ..	140	11	3	9	5,986	15	9
Dec. ..	146	11	3	17	5,857	11	2
1842.							
March..	155	0	2	14	5,743	1	11
June ..	106	12	1	4	3,793	1	6
Sept. ..	132	15	3	26	5,197	18	9
Dec. ..	118	18	0	7	4,134	5	8
1843.							
March..	94	11	3	5	3,247	7	6
June ..	93	19	1	10	3,199	3	4
Sept. ..	87	3	2	5	3,015	4	0
Dec. ..	92	6	3	1	3,425	0	1
1844.							
March..	86	2	2	6	3,404	6	6
June ..	86	8	3	13	3,508	18	1
Sept. ..	81	7	1	7	3,324	2	0
Dec. ..	121	10	0	26	4,920	16	4
1845.							
March..	132	9	0	26	5,232	4	1
June ..	96	8	3	19	4,794	14	9
Sept. ..	100	1	2	16	5,086	16	3
Dec. ..	92	4	0	11	4,955	8	7

	Tons	cwt.	qr.	lb.	Amount. £	s.	d.
1846.							
March..	121	17	0	14	5,901	15	2
June ..	109	8	3	5	5,259	19	3
Sept. ..	104	14	1	14	5,191	6	6
Dec. ..	82	9	0	18	4,062	4	8
1847.							
March..	94	14	3	10	4,481	18	8
June ..	88	0	2	17	3,939	4	6
Sept. ..	79	16	1	24	3,485	15	9
Dec. ..	77	2	1	13	3,190	8	3
1848.							
March..	80	14	0	10	3,145	6	5
June ..	85	2	1	21	3,162	19	6
Sept. ..	85	3	1	19	3,378	6	6
Dec. ..	81	17	3	8	3,639	0	8
1849.							
March..	82	8	1	3	3,486	4	0
June ..	73	14	2	9	2,729	14	6
Sept. ..	79	13	2	4	3,107	7	7
Dec. ..	76	9	0	8	3,278	11	6
1850.							
March..	84	18	2	1	3,357	11	0
June ..	75	9	2	24	3,135	1	0
Sept. ..	67	13	3	6	2,834	13	4
Dec. ..	84	19	0	14	3,725	6	3
1851.							
March..	82	6	2	26	3,484	8	5
June ..	76	11	3	24	3,174	15	6
Sept. ..	51	12	2	24	2,196	0	0
Dec. ..	80	18	3	16	3,677	12	11
1852.							
March..	73	15	2	24	3,277	0	11
June ..	69	16	3	15	3,319	9	8
Sept. ..	61	14	1	12	3,238	4	2
Dec. ..	68	15	1	10	3,956	15	1
1853.							
March..	55	15	3	8	3,205	5	4
June ..	53	16	0	2	3,033	2	9
Sept. ..	63	18	1	14	4,404	12	10
Dec. ..	62	14	0	26	4,003	3	6
1854.							
March..	47	16	0	7	3,002	1	0
June ..	51	12	3	12	3,084	4	6
Sept. ..	52	14	1	26	3,253	3	8
Dec. ..	49	4	1	13	2,845	4	4
1855.							
March..	53	10	0	24	3,075	10	5
June ..	52	18	0	27	3,235	7	4
Sept. ..	57	15	2	17	3,572	15	6
Dec. ..	49	16	1	13	3,239	19	4
1856.							
March..	49	13	3	11	3,377	1	3
June ..	53	9	2	12	3,494	9	7
Sept. ..	52	16	3	3	3,728	10	6
Dec. ..	53	7	0	24	3,938	7	8

1857.	Tons	cwt.	qr.	lb.	Amount. £	s.	d.
March..	50	13	0	19	3,666	12	0
June ..	48	16	0	13	3,255	1	6
Sept. ..	57	0	0	19	3,600	11	1
Dec. ..	54	12	0	18	3,114	15	2
1858.							
March..	65	1	3	21	3,924	14	5
June ..	65	9	2	20	4,003	13	9
Sept. ..	63	6	2	2	4,021	15	3
Dec. ..	91	10	3	20	6,339	9	7
1859.							
March..	86	13	1	22	6,152	13	9
June ..	89	18	0	13	6,536	5	8
Sept. ..	74	1	1	10	5,674	12	2
Dec. ..	80	5	3	14	6,342	15	7

1860.	Tons	cwt.	qr.	lb.	Amount. £	s.	d.
March..	75	16	0	24	5,737	18	10
June ..	75	8	0	20	5,977	15	4
Sept. ..	64	8	2	5	4,999	15	5
Dec. ..	60	17	1	24	4,415	6	11
1861.							
March..	68	4	1	27	4,582	14	2
June ..	65	10	0	17	4,125	7	10
Sept. ..	63	0	3	3	4,135	19	7
Dec. ..	57	7	3	3	3,640	15	8
1862.							
March..	68	5	3	9	4,072	8	7
June ..	68	8	2	2	4,052	15	4
Sept. ..	63	3	2	4	3,935	13	5
Dec. ..	64	5	0	13	3,876	17	7
					£478,030	15	0

The surface of St. Ives Consols is divided into a remarkable quantity of small inclosures, belonging to a great number of different people. There are considerably upwards of twenty lords; and that a mine can be worked at all under such circumstances shows the excellent system of mutual conciliation which is so characteristic of Cornish landlords, in the granting of mining setts.

It is worthy of remark that here, as in the extreme western districts generally, the men bore single-handed, with hammers weighing from 5 to 6 lbs.

To the east of St. Ives Consols, nearer the town, is TRENWITH MINE, worked for copper in greenstone and hornblendic schists. In its original working this mine made fine profits from copper; but a more recent working within the last dozen years was a complete failure.

Abstracts and Reviews.

WHITNEY'S REPORT ON THE UPPER MISSISSIPPI LEAD REGION.

Report of a Geological Survey of the Upper Mississippi Lead Region, by J. D. Whitney. Made by the authority of the Legislature of Wisconsin, under a contract with Professor James Hall, Principal of the Geological Commission of the State, in 1859–60. Albany, N. Y., 1862.

The economical importance of the great lead district of the Upper Mississippi, extending from the State of Wisconsin, in which it has its most extensive development, southward into Illinois, and westward across the Mississippi into Iowa, is well known in this country—for it has been, for many years, one of the favourite resorts for our mining emigrants. The lead deposits of this region are not only by far the most important, as far as known, of that metal on the American Continent, but they yield one-eighth of the entire lead produced throughout the world.

Such a great source of natural wealth, situated in a temperate climate, and traversed by a river like the Mississippi, obviously shows one of the

finest fields for industry affordable even by the teeming resources of the American Continent; and the accurate description of a district so important, by one so competent to undertake the task as Professor Whitney, is necessarily one of the most valuable of the recent additions to mining literature. Indeed Professor Whitney approaches his task with a position and knowledge rarely possessed, for—like Mr. Warington Smyth in this country—he one is of those (unfortunately too few) who combine a competent knowledge of geology with a large amount of practical mining experience; and whose opinions on such a district consequently carry a weight which those of no mere geologist or mere miner could possibly possess. From the author of the *Metallic Wealth of the United States* we expected a sound review of any metallic mining district he undertook; yet in reading this Report we were further struck with the justness of the views he has taken as to the mining future of the Mississippi lead district—views which a wide experience of European districts satisfies us is thoroughly sound. We may here state that since the completion of his labours in Wisconsin, in October 1860, Professor Whitney has been engaged, as State Geologist, in a Geological and Natural History Survey of California, which is advancing as fast as the present disturbed condition of the United States will allow.

The present volume forms part of the "Report on the Geological Survey of the State of Wisconsin," prepared under the direction of Professor Hall, from whom Professor Whitney purchased a small number of copies of the text and illustrations of his portion of the Report, for distribution, as a separate and independent work with a suitable title-page, among his personal friends and those interested in the subject. The Reports as published by Professor Hall included an introductory chapter on "The Physical Geography and General Geology of Wisconsin;" but as Professor Whitney's Report is a complete work in itself, it is properly enough put forth as a separate volume.

It must be remembered that the lead districts of the West are divisible into two great fields, commonly distinguished as the Upper and Lower Mines; and that it is to the former, which form the well-characterised region in Wisconsin, Illinois and Iowa already referred to, that this report is exclusively confined. The Lower or Missouri Mines, as they may properly be called, are situated principally near Big River and Mineral Creek, branches of the Maramec River within the limits of Washington county, Missouri: they are an entirely distinct district, but yet have many features in common with the Upper Mines.*

The lead district of the Upper Mines may be approximately described as included between the Mississippi, Wisconsin and Rock rivers, which bound it respectively on the west, north and east, forming a tract of about 3,000 square miles in area, with an extreme length of 90 miles from east to west and 55 miles from north to south. Fully five-sixths of this tract lies within the state of Wisconsin, but it also extends (as already stated) some way south into Illinois and west into Iowa; and as the richest portion of the region lies near the junction of the three states, it happens that Illinois and Iowa each produce, in proportion to the extent of surface mined, more lead than Wisconsin. The accompanying sketch map, Fig. 15, which shows the lead district within the dotted line, gives some idea of its position. It will be observed that it extends from a little south of latitude

* There are also a few others in Franklin county on the Maramec, and one or two in Jefferson county, not many miles south of St. Louis. Quite recently discoveries of lead ore have also been made on the western borders of Missouri; but all these mines are geologically as well as geographically quite distinct from those of the lead region of the lower mines above-mentioned, situated at the confluence of the Missouri and *Mississippi* rivers, on the south side of the former.

42° 30′, to a little north of latitude 43°—that is, the latitude is about the same as that of the North of Spain.

The physical character of this region is not that of one broken by lofty elevations, for the highest points scarcely rise more than 100 feet above the level of the water-courses. As shown by the map it extends a little to the north of the east and west ridge that forms the water-shed between the streams flowing north into the Wisconsin, and those flowing south directly into the Mississippi. The central portion is drained by the numerous branches of the Peccatonica which flow east of south into the Rock river, through the State of Illinois. Its eastern portion is drained by the Sugar river and its branches, which is also a tributary of Rock river. The Fever, Platte, and Grant rivers, flowing directly into the Mississippi, drain the south-western portion. To the north of the water-shed line the streams flowing into the Wisconsin are small and rapid.

The rocks forming the surface of this region are all stratified, and are ascertained to be of Silurian age, the following is their succession :—

	Name.	Thickness. Feet.	Mineral Characteristics.
Upper Silurian ..	1. Niagara Limestone	300	Dolomite, closely resembling galena limestone.
Lower Silurian ..	2. Hudson River Group	70 100	Silicious shale, sometimes bituminous.
	3. Galena Limestone	250	Dolomite. The chief depository of the lead ore.
	4. Trenton Limestone	50 100	Pure limestones, with beds of argillaceous shale. Lower beds dolomite.
	5. Upper Sandstone	72 100	Pure silicious sandstone.
	6. Lower Magnesian Limestone ..	250 300	Dolomite frequently brecciated, containing small deposits of lead ore.
	7. Lower Sandstone	300 400	Silicious sandstone, often ferruginous.

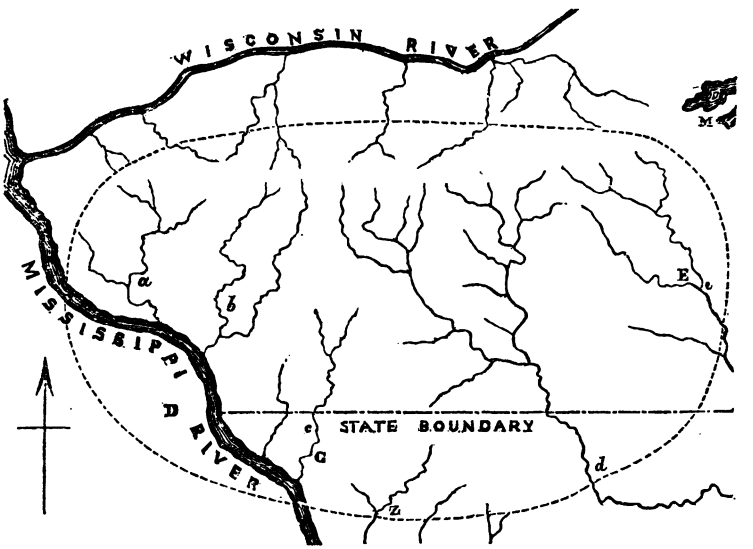
The *Lower Sandstone*, which is the same as the Potsdam sandstone of the New York Geological Survey, is the lowest sedimentary fossiliferous sandstone of the north-west. In Wisconsin it occupies a large extent of surface, forming part of a continuous series extending from the State of New York, through Canada, along the south shore of Lake Superior to Chocolate river, where it divides into two branches, one reaching into Western Wisconsin. Within the limits of the Lead Region proper the Lower Sandstone nowhere comes to the surface; but on the north side of the water-shed, in the beds of the streams running down to the Wisconsin it makes its appearance. There can be no doubt, however, that this sandstone underlies the whole lead region; but in an economical point of view this is unimportant, for this rock has been unproductive everywhere except in the Lake Superior region, where its whole character is changed by the presence of irruptive rocks. Masses of peroxide of iron are of occasional occurrence, but not in quantities of commercial value.

The *Lower Magnesiun Limestone*, which is the equivalent of the Calciferous sandstone of the New York Geological Reports, covers a large area in Wisconsin. It is almost entirely made up of chemically pure dolomite, that is of equal equivalents of carbonate of lime and carbonate of magnesia: some of the beds near the bottom are made up of a mixture of sand and dolomitic material, and might be called dolomitic sandstone. The litholo-

gical character of this Magnesian Limestone is that of rather heavy-bedded and irregular layers of light greyish-yellow or greyish-white rock, finely crystalline or compact in texture, brittle, breaking with an irregular and rather conchoidal fracture, and resisting well the action of the weather. Like the Lower sandstone it is marked by an almost entire absence of argillaceous matter.

FIG. 15.

SKETCH MAP OF THE UPPER MISSISSIPPI LEAD DISTRICT.



D, Dubuque. G, Galena. E, Exeter. Z, Elizabeth. M, Madison (latitude 43° 2′ 1″; latitude 91° 8′ 37″).

a, Grant River. *b*, Platte River. *c*, Fever River. *d*, Peccatonica. *e*, Sugar River.

Within the limits of the lead region this rock is frequently exposed in the valleys, but it never rises high enough to permit its whole thickness to be observed. Ascending any of the streams which flow into the Wisconsin from the south we soon come upon the Lower Magnesian, but rise above it with the country of the south. Descending the opposite southern ridge of the water-shed we find the rock there exposed in the valleys of most of the principal streams—on Grant river, Platte river, the Legate and Dougherty branches of the Peccatonica, on the latter river, south of the Wyota, and on Sugar river. As to the metalliferous contents of this rock, but small quantities of lead have yet been found in it and no ores of any other metals; and as to the probability of the lead veins of the upper productive Galena Limestone being found to penetrate and to be productive here, that has been a matter of much discussion as we shall see further on.

The *Upper Sandstone* is the lowest member of the series that occupies any considerable extent of surface in the Lead Region proper. In the Eastern States as far west as Lake Superior there is no silicious rock analogous to this in position; it begins to be first recognised to the south of Winnebago Lake. Its lithological character is very similar to that of the Lower Sandstone, being made up of almost chemically pure silicious material, very friable. There are two remarkable facts connected with this

bed; the first is its uniform thickness throughout the whole north-west—never exceeding 100 or falling below 72 feet, for an area of at least 400 miles by 100 miles in width; the second is its abrupt transition into the limestones or dolomites, above or below, there being no transition beds in any case.

As stated, this rock has a wide distribution in the lead district. There is scarcely a stream of any consequence in Wisconsin that does not cut down to it; and along these it usually forms precipitous bluffs, although rarely extending back for any considerable distance. At some points it exhibits picturesque outliers.

The beds which lie between the Upper Sandstone and the Galena Limestone, comprising a vertical series varying from between 50 to 100 feet in thickness, have hitherto been called the "Blue Limestone." They seem to be divisible into two well-marked groups—the upper, comprising two-thirds or three-fourths of the whole, a pure limestone forming the Blue Limestone proper—and a lower and thinner but still well constituted member, of dolomite, commonly known as the "Buff Limestone." These Professor Whitney has classed together in his map under the name of the Trenton Limestone, as they are undoubtedly pretty nearly the equivalents of the rocks of that name of the New York Survey.

Everywhere throughout the lead region, when the top of the Upper Sandstone is exposed, a series of dolomitic beds is found overlying it, with a tolerably uniform thickness of from 15 to 20 feet. This dolomite or Buff limestone is sometimes heavy and sometimes thin-bedded, and somewhat argillaceous. At points it passes imperceptibly into the purely calcareous rock above (Blue Limestone proper), which, everywhere throughout the district, forms a considerable thickness of strata of purely calcareous matter, marked by the entire absence of magnesia.

The lower beds of Blue Limestone, lying immediately above the Buff dolomite, are known in the district as the "Glass Rock," from their compact texture and peculiar conchoidal fracture somewhat resembling that of glass. The main body, however, is made up of blue, thin-bedded, rather shaly and argillaceous layers, which undergo decomposition rather rapidly. This rock is well exposed in the bluffs which border almost all the streams running through the lead region; and round the head-waters of the Grant and Platte rivers, on the Fever river and the main Peccatonica it is the lowest rock exposed. It also occupies a large portion of the surface round the head-waters of the east Peccatonica and some of those of the Sugar river.

In some of the northern portions of the district the Blue Limestone is a metalliferous rock, producing a fair quantity of lead; although on the whole it does not seem that it can be considered productive for that metal; but it produces the "dry-bone" or carbonate of zinc in great abundance in connection with the sulphurets of lead, zinc and iron.

The *Galena Limestone* is, however, by far the most important in the lead region, since it not only covers by far the larger portion of its surface but is the chief repository of the lead ores. It is a pure dolomite, made up exactly of equivalent proportions of carbonates of lime and magnesia; is usually thick-bedded, of a light grey or light yellowish-grey colour and a fine crystalline texture—showing on the whole a great uniformity of character. Its thickness, where it can be measured, from the top of the Blue Limestone to the overlying Hudson River group is about 250 feet. The upper 50 feet are usually more regularly and thinly bedded than the middle and lower portions; the middle portion is less argillaceous and more crystalline than the beds above, and the lower division is more irregular in its lithological character than either of those upward—some portions not unfrequently showing a gradual passage by a series of calcareo-magnesia and argillaceous beds into the Blue Limestone beneath.

The same thing is true of the upper portion of the upper division of this rock, which passes by a series of thin shaly beds into the Hudson River group. As we shall have to refer to this portion of the series in describing the lead deposits, it will be unnecessary to dwell upon it further here.

The *Hudson River* group, as its name indicates, is the representative of the strata of the same name of the New York Survey. On the banks of the Hudson River they have a dark colour owing to the presence of bituminous matter, as they extend west into Canada they become more calcareous: but in the vicinity of the Mississippi the series here again becomes almost purely detrital. They occupy only a very trifling area in Wisconsin, the most important being about the Fairplay Diggings, near the southern limits of the State, but on the west of the Mississippi, in the neighbourhood of Dabuque, and Jackson's Mound, and in Illinois near Scales Mound, and Apple River, on the line of the Illinois Central Railway, they have some considerable development. At Scales Mound they consist of alternating bands of silico-calcareous shales and argillaceous shales; and near Dabuque a considerable thickness has to be penetrated by shafts before the lead-bearing Galena Limestone below is reached. But the most interesting fact connected with this group is the large amount of organic matter which it frequently contains, sometimes making up from one-tenth to one-fifth of the whole.

The *Niagara Limestone*, forming the upper member of the series, covers but a small surface of the lead region—and then only as detached eminences or "mounds;" but east, south, and west of the district it occupies a large area. It likewise is found to be the representative of the group of the same name in New York and at Niagara Falls. Economically this rock is of little importance, for it is not known to contain minerals of economic value.

(*To be continued.*)

NOTE ON THE MANUFACTURE OF HEMATITE PIG-IRON IN NORTH LANCASHIRE AND CUMBERLAND.

By M. S. Jordan.

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(Abstracted from the *Revue Universelle.*)

(*Continued from page* 98.)

Description of the Ulverstone Works.

The Ulverstone Hematite Iron-works, situated, as already stated, at the port of Barrow, at the extremity of the peninsula of Low Furness, belong to Messrs. Schneider and Hannay, whose residences and offices are at Ulverstone. They were laid out for four furnaces, calculated to make altogether 800 tons of pig-iron per week, and their erection commenced in 1859. In 1860 they had already reached a production of nearly 47,000 tons with three furnaces, which had not all been in blast during the twelve months.

Two new furnaces were commenced in 1861, and the production of the year, from four furnaces on an average, exceeded 70,000 tons, although the blast engines were beginning to be insufficient for the number of furnaces at work.

In 1862, a seventh furnace was begun, the lower part of which only remains to be built, and another powerful blast-engine has been put up, in addition to the two existing previously. Six furnaces are at present in blast, producing about 2,500 tons of pig-metal per week—or an average of upwards of 60 tons per furnace per 24 hours, a production hitherto unparalleled in the metallurgy of iron.

Before commencing the special description of the various apparatus at

the works, it may be well to state their position in September 1862, when there were :—

Seven furnaces, of which six were in blast.

Three blast-engines.

Ten large steam-boilers, heated by the waste gases, for the supply of these blast-engines.

Fourteen hot-blast stoves, heated by the waste gases.

Two steam-engines for working the gas-exhausters.

Two fixed steam-engines for working the inclined-plane lifting apparatus.

Four-steam boilers, heated by the waste gases, for the supply of these four engines ; besides various accessory apparatus and plant.

Forms, Dimensions and Construction of the Blast-furnaces.—The six furnaces at present in blast are not all of the same dimensions, and do not all produce the same quality of pig-iron. The two old furnaces (Nos. 1 and 2) are only 15′ in diameter at the body ; Nos. 3 and 4 are 15′ 6″ ; and the three most recent ones, Nos. 5, 6 and 7, are 16′. The diameters of the throat have a corresponding variation, but the other dimensions are nearly the same for the whole seven furnaces.

The following are the dimensions :—

Diameter at the throat	.. ..	11′ to 12′
„ „ body	.. ..	15′ „ 16′
„ „ twyers	.. ..	8′ 6″
„ „ sole..	.. ..	6′
Height from the sole to the throat	.. .. ..	46′
„ „ top of boshes	.. ..	17′
„ „ twyers..	.. ..	8′

In Fig. 1, Plate I,* will be found the lines of these furnaces, on which it is only necessary to remark—the enlargement of the throat, the absence of any distinct hearth properly so called, and the large transverse dimensions at the level of the twyers. The entire lining is of refractory brick, including the facing of the crucible, which is of large and peculiarly formed bricks, and the thickness of which does not exceed 3′ 4″.

These round furnaces have scarcely any massive exterior stack. At the height of about 12′, is placed a strong cast-iron ring or cornice, cast in segments, supported by ten or twelve columns arranged at regular intervals. Between these columns is seen, as shown in Plate II, Fig. 6, the refractory walls of the hearth and crucible of the furnace. Behind each column, and within the circle which they form, is a vertical cast-iron binder ; and it is these ten or twelve binders which really support, by means of circular wrought-iron hoops, the body and stack. The stack is almost cylindrical, and has but a trifling thickness about the belly, for the exterior diameter is scarcely 21′ 6″. There is no space between the fire-brick lining and the outer masonry, which on the contrary are worked together ; but the whole is enveloped in a casing or mantle of stout wrought-iron plates, from the ring or cornice to the throat of the furnace. Between this casing and the masonry there is left a space of 2″ or 3″, which is rammed with fine sand, and which allows a certain play to the masonry on the furnace being blown-in.

The projecting ring or cornice which, supported by the columns, goes all round the furnace, is cast hollow, and contains the blast and water-pipes. The blast-pipe enters the ring at the back of the furnace, and continues all round ; it has 9 or 10 socket-pieces underneath, into which are fixed the descending nose-pipes that carry the blast to the twyers. The cast-iron columns (of which there are ten for furnaces Nos. 1, 2, 3 and 4,

* See last number of *Mining and Smelting Magazine.*

and twelve for Nos. 5, 6 and 7), and the wrought-iron vertical binders, form, about the bottom part of the furnace, ten or twelve embrasures, of which the front one is the more spacious. It would be possible to insert nine or ten twyers in these embrasures, and the circular blast-pipe has this number of socket-pieces, but only six are put in, and in furnaces Nos. 1, 2, 3 and 4, but five are ordinarily used: all these are distributed regularly round the diameter of the furnace. The nose-pipes are very simple, about 6″ in diameter, and without valve or clack, being merely pierced with a hole opposite the eye of the twyer which is closed with a plug (see Fig. 3, Plate I).—A single valve, placed behind the furnace, serves at once to cut off the blast from all the twyers, which have an internal circulation of water, distributed with a great deal of care; but there are neither water-blocks nor water-breasts at the twyers or at the tymp.

From the preceding description it will be seen that, in their lines, these furnaces resemble those of the Clyde, particularly in the absence of any hearth properly so called; in their construction they approach the new furnaces of Staffordshire and Middlesborough in the lightness of their mass, their casing of wrought-iron, and their columns. In France we know nothing analogous to these lines; but we have several examples of a similar construction in the basin of the Moselle, and in the new furnaces of Franche-Comté. The advantages of this system of constructing furnaces—called in England Cupola Furnaces—may be summed up as follows:—

Lightness of construction; economy in the foundations; rapidity in building and drying; the absence of scaffolding and expansion, so troublesome in large new masses; the power of enlarging or decreasing the belly at a trifling cost; the facilities for employing numerous twyers at various heights if necessary; the free passage round the crucible, affording ready means for repairs in case of accident; and lastly shorter stoppages.

Collection of the Furnace-gases.—In the Ulverstone furnaces we have seen that the diameter of the throat is considerable, so that, in endeavouring to collect and utilise the gases, those difficulties have been met with, which so many engineers had already encountered when seeking to enlarge the throats of furnaces, and at the same time to make the gases available. MM. Grüner and Lan give the case of the Pouzin works where, with a body 15′ in diameter, it was not found possible to carry the diameter of the throat beyond 6′ 6″ without deranging the working of the furnace; and instances of other French works might be given, where similar inconveniences have been met with. In English works, as MM. Grüner and Lan explain, this is less felt, since the calcined coal-measure ores used are extremely reductible, and are charged in large pieces; and also because the utilisation of the gases is less general than in France.

The Ulverstone works, from their position and the consequent dearness of coke, are situated similarly to most of the French works; so that the economising of fuel, by utilising the gases, is a matter of much importance. But the ores not being those of the coal-measures, but, on the contrary, oxidised ores very similar to those of Lavoulte and Privas, the difficulties to be encountered were considerable. Without, we are satisfied, having any knowledge of the system of M. Coingt, of Montluçon, and instigated probably by the ideas of Dr. Parry, Mr. J. T. Smith, the engineer of the works, has conceived a system of collecting the gases—by which, judging from the experience of three years, he has succeeded in solving the problem.

Under this system, like most of those adopted in England for several years, and particularly like that of the Old Park Works, the gases are taken from the centre of the throat; but, unlike the arrangement in these cases, the cylinder is not immersed in the furnace. The gases are collected in a strong wrought-iron cylinder lined, in the interior, with a coating of refractory bricks. This cylinder, which goes down about 5′ below the

level of the throat, is fixed vertically on a circular crown formed of six specially moulded blocks of refractory clay, supported by six buttresses of refractory masonry, as shewn in Fig. 2, Plate I.

These buttresses and the circular crown form, across the body of the furnace, a species of dome with seven openings: one in the centre, for the escape of the gases, and six at the circumference for the descent of the charges. Between the space beneath this dome and the charge, there always remains a space in which the gases accumulate, and whence they are withdrawn by the central cylinder—except a small proportion which escapes and burns at the throat. The cylinder—whose interior diameter is 4′6″—is surrounded also by a thin walling of about 6″ of refractory brick. Round the throat of the furnace is the usual brick chimney or tunnel-head, of the same diameter and about 12′ high. This chimney has six openings for filling-places, corresponding to the six openings of the dome, fitted with iron swing doors. The charging is effected by ordinary wooden barrows, which, although they seem primitive, answer very well.

The platforms of the furnaces are very large, about 27′ in diameter, formed of a flooring of cast-iron plates, with a railing about 3′ 6″ high. All the platforms of the six furnaces communicate by wide bridges, so that the barrows can pass freely from one end to the other of the range.

The vertical cylinder that collects the gases is connected with another horizontal wrought-iron cylinder supported by the chimney. This cylinder, which is closed at one extremity, is turned perpendicularly at the other; and by it the gases are carried into a large wrought-iron tube, about 40″ in diameter, and upwards of 100 yards long (placed behind the range of furnaces at a height of about 13′ above the level of the ground), which acts as a general reservoir for the furnace gases, and whence they are carried to the various points where they are required to be utilised.

Blowing Engines.—There are three blowing-engines, all beam engines, each with a single blast-cylinder and a separate fly-wheel moved by a span-beam attached to the beam by a connection behind the steam-cylinder, as shown in Fig. 4, Plate I. They are all fitted up with the highest finish, and a certain extent of decoration, which, taken in connection with their picturesque position, gives an unusual charm to the works. The engines Nos. 1 and 2 are of exactly the same nominal power, 120 H.P.: the steam-cylinders are 47″, the blast cylinders 98″, and the stroke 9′ The engine No. 3 is larger: 15 H.P., steam-cylinder 50″, blast-cylinder 105″, the stroke being still 9′. All three use steam of a pressure of 25 lbs. per square inch, and work expansively. They all blow into the same regulator, and are capable of discharging per minute 48,000 cubic feet, at a density of 3 lb. per square inch. Engines Nos. 1 and 2 give from 15 to 16, and engine No. 3 from 18 to 20 double-strokes per minute. The minimum speed of Engines Nos. 1 and 2 was 4′ 6″ per second, and the maximum speed of No. 3 was 6′ per second. At these speeds not the least vibration was noticeable, and the clacks worked almost without noise. There are, however, engines in England that work at a much greater speed—for instance that of Dowlais, which attains a speed of 7′ 8″ with 19 double strokes per minute.

The three engines drive the blast into a regulator composed of two wrought-iron tubes of about 40″ in diameter and upwards of 100 yards long, placed behind the range of furnaces, and supported by the hot-air apparatus to which they distribute the blast.

Steam Boilers.—The boilers that supply the three blast-engines are divided into two sets. The first consists of three similar boilers, each 35′ long and 6′ 6″ in diameter, containing two fire-tubes of 2′ diameter. These fire-tubes project about 16″ beyond the end of the outer tube of the boiler,

and are closed with an iron plate in which are two doors—one for the furnace, aud the other for the ash-pit. The doors of the ash-pits are solid, but those of the furnaces have each a round opening of angular segments, as shown in Fig 5, Plate I. The fire-grate, which is horizontal, is in the middle of the tube, and is about 3′ 6″ long. The gases arrive above each fire-grate by a vertical flattened tube, perpendicular to the furnace, where they are mixed with the necessary proportion of air, which is admitted by the opening shown in Fig. 5. The ash-pit is always kept hermetically closed. The flame circulates in two currents, each the length of the tube, before passing into the common stack or chimney. When we visited the works, these six boilers were in action, and supplied engines Nos. 2 and 3—one making 14 and the other from 17 to 18 double-strokes.

The second set consists of four non-tubular boilers, also 35′ long, but of a rather less diameter (6′). The gases also arrive perpendicularly to the front of the boiler by two lateral flues situated underneath it. Each of these flues has a fire-grate and doors similar to those in the fire-tubes of the first set.

It is expected that the boilers of this set, which have not yet been lighted, will give a considerably better result than those of the first set. From results already obtained, it is expected that, with eight boilers, six furnaces may be supplied with blast, with a consumption, at the outside, of 1 cwt. of coal per ton of pig-metal produced.

(*To be continued.*)

THE BOARD OF TRADE RETURNS.

The "Accounts relating to Trade and Navigation of the United Kingdom, for the month ended 31st December, 1862, and year ended 31st December, 1862," have been issued by the Statistical Department, Board of Trade.

IMPORTS.—The quantities and relative increase and decrease of the imports of metals, metallic ores, and mineral products, for the month and year ended 31st December, have been as follows :—

	Month ended 31st December.			Year ended 31st December.		
	1861.	1862.	Increase (+) or Decrease (−).	1861.	1862.	Increase (+) or Decrease (−).
Brimstone ... ... cwt.	95,242	81,593	− 13,649	865,646	1,067,387	+201,741
Copper Ore ... ... tons	8,741	9,536	+ 795	74,163	82,054	+ 7,891
Copper Regulus ... ... „	2,183	5,567	+ 3,384	20,317	35,388	+ 15,071
Copper, unwrought and part wrought ... cwt.	52,740	24,826	− 27,914	315,760	268,666	− 47,094
Iron, in Bars, unwrought tons	4,066	10,510	+ 6,444	35,489	49,662	+ 14,173
Steel, unwrought ... „	567	1,254	+ 687	3,706	5,050	+ 1,344
Lead, Pig, and Sheet ... „	5,882	3,756	− 2,126	23,109	23,693	+ 584
Spelter or Zinc ... ... „	5,680	6,079	+ 399	24,851	23,709	− 1,142
Tin, in Blocks, Ingots, Bars, or Slabs ... cwt.	20,688	20,311	− 372	73,062	87,873	+ 14,811
Silver Ore ... ... value in £	30,095	57,918	+ 27,823	289,373	331,564	+ 42,191
Quicksilver ... ... lbs	70,556	104,278	+ 33,722	1,915,909	1,161,352	−754,557

EXPORTS.—The quantities, declared value, and relative increase and decrease of the exports of metals, minerals, and metallurgical articles of British and Irish produce and manufactures, for the month and year ended 31st December, have been as follows :—

	QUANTITIES.				DECLARED VALUE.					
	Month ended 31st December.		Year ended 31st December.		Month ended 31st December.			Year ended 31st December.		
	1861.	1862.	1861.	1862.	1861.	1862.	Increase (+) or Decrease (−)	1861.	1862.	Increase (+) or Decrease (−)
					£	£	£	£	£	£
Alkali: Soda ... ...cwt.	141,640	191,523	1,420,327	2,093,286	57,622	81,509	+ 23,887	605,278	885,471	+ 280,193
Coal, Cinders, and Culm ...tons	477,282	618,150	7,855,115	8,317,913	238,186	287,226	+ 49,040	3,604,790	3,750,009	+ 145,219
Iron, Pig and Puddled ... ... „	22,802	28,426	388,004	445,093	57,960	77,698	+ 19,738	1,044,304	1,204,584	+ 160,280
Iron, Bar, Angle, Bolt, and Rod... „	23,170	27,165	258,074	305,295	166,687	209,316	+ 42,529	1,882,275	2,252,638	+ 370,363
Railroad Iron, of all sorts ... „	18,342	29,506	377,565	402,411	144,237	220,215	+ 75,978	2,906,359	2,815,007	− 91,352
Iron Wire ... ... „	933	1,987	11,811	14,333	12,385	39,492	+ 27,107	205,979	303,780	+ 97,801
Iron, Cast ... ... „	5,704	6,036	75,055	65,205	60,642	53,314	− 7,428	702,824	568,209	− 134,615
Iron Hoops, Sheets, and Boiler Plates ... ... „	7,164	8,798	88,885	104,099	68,765	87,846	+ 19,081	848,336	1,024,176	+ 175,840
Iron, wrought, of all sorts ... „	7,154	12,638	106,490	136,640	140,861	240,806	+ 99,945	2,009,613	2,311,251	+ 301,638
Iron Steel, unwrought ... ... „	1,972	2,170	21,810	24,989	70,425	78,158	+ 7,733	726,956	822,407	+ 95,451
Copper, unwrought, in Ingots, Cakes, or Slabs ... ... cwt.	6,170	5,646	87,351	101,455	28,731	28,011	− 720	433,410	496,322	+ 62,912
Copper, wrought or partly wrought, Bars, Rods, Bottoms, Pans, Plates, Sheets, and Nails; and mixed or Yellow Metal for Sheathing .. „	30,281	34,979	301,052	419,192	142,655	161,454	+ 18,799	1,439,347	1,962,308	+ 522,961
Copper, wrought, of other sorts... „	3,847	1,590	47,171	26,059	26,294	9,156	− 17,138	275,098	154,784	− 120,314
Brass of all sorts ... ... „	2,936	3,406	30,435	38,329	18,379	20,013	+ 1,634	171,050	209,461	+ 38,411
Lead, Pig, Rolled, Sheet, Piping, Tubing, and Lead Shot tons	1,170	3,580	19,295	36,348	24,503	76,994	+ 52,491	423,421	770,590	+ 347,169
Lead, Ore, Lead, Red and White, and Litharge of Lead ... „	536	491	5,851	7,590	11,315	10,768	− 547	146,701	172,180	+ 25,479
Tin, unwrought ... ...cwt.	3,364	6,562	56,673	81,913	20,333	36,447	+ 16,114	343,856	472,656	+ 128,800
Tin Plates ... ... „	—	58,612	—	1,001,532	90,126	72,312	− 17,814	907,947	1,211,081	+ 303,134
Zinc or Spelter, wrought or unwrought ... ... „	5,288	11,960	87,746	101,050	6,106	12,236	+ 6,130	95,786	102,700	+ 6,914
Salt ... ...tons	36,887	40,269	703,132	669,838	18,157	18,167	+ 10	370,255	321,006	− 49,249
					1,404,369	1,820,938	+ 416,569	19,143,585	21,810,620	+2,667,035

ON THE MINES, MINERALS, AND MINERS OF THE UNITED KINGDOM.

By Robert Hunt, F.R.S., Keeper of Mining Records, Royal School of Mines.

(Read before the Society of Arts, December 17, 1862.)

(*Continued from page* 103.)

Two views, however, which have been variously modified by different writers on geognostical, as distinguished from geological phenomena, prevail. One, represented by Hutton and Playfair, is intimately connected with the igneous hypothesis of the earth's formation; while the other which may be said to be embodied in the views of Werner, supposes all mineral deposits to have taken place from water.

"Look," says Dr. Hutton, "into the sources of our mineral treasures. Ask the miner from whence has come the metal in his veins. Not from the earth or air above, nor from the strata which the vein traverses; these do not contain an atom of the minerals now considered. There is but one place from whence these minerals may have come—this is the bowels of the earth, the place of power and expansion; the place from whence has proceeded that intense heat by which loose materials have been consolidated into rocks, as well as that enormous force by which the regular strata have been broken and displaced."—*Theory of the Earth*, vol. i. p. 180.

"What I may challenge as my own particular discovery," writes Werner, "is, *a*, to have determined and described in a more particular manner the internal structure of veins as well as the formation of the different substances of which they are composed, and to have settled the relative age of each; *b*, to have given the most accurate observations and most perfect knowledge of the meetings and intersections of veins, and to have made these observations subservient to the determining their relative ages; *c*, to have determined the different vein formations, particularly metalliferous veins, as well as their age; *d*, to have been the first who entertained the idea that the spaces which veins occupy were filled by precipitations from solutions,"—*New Theory of the Formation of Veins: Abraham Gottlob Werner.*

Geological philosophers conceive it to be necessary to start with the hypothesis of a cooling sphere. Without this they believe they are not enabled to account for many of the phenomena which are presented to them in the wide field of their interesting labours. That many rocks bear unmistakable evidence of an igneous origin cannot be denied. They have been forced by some tremendous subterranean power through the superincumbent strata—they have altered the character of the rocks through which they have passed—they have overflowed at the surface, and spread out upon the sedimentary formations, and their physical structure and chemical composition prove them to have been once fluid or plastic under the influence of heat. Beyond those truly igneous rocks, many of the deep seated masses forming the earth's crust have been referred to the action of heat. For a long period the Plutonic theory prevailed, and mineral formations were, without exception, involved within its fiery mantle. Eventually, as the science of geology passed from the regions of speculation into tho more trustworthy paths of observation, it was seen that water had played, and is still performing, some most important parts in the earth's mutations. Consequently the balance now oscillates with a tolerable degree of uniformity between fire and water.

We have only to deal with these views in their relation to metalliferous deposits, The "Mineral Veins" of Mr. Belt* supports the igneous origin

* *Mineral Veins: an Inquiry into their origin, founded on a study of the Auriferous Quartz Veins of Australia.* By Thomas Belt. London: Weale.

of the quartz veins, or "reefs," as they are called of Australia. He thinks that he perceives in them conditions analogous to the trap dykes—which he had previously studied—intersecting the coal fields of Durham and Northumberland. Mr. Belt says "If we admit the igneous origin of granite, and British geologists at least have admitted it, the conditions under which it must have been intruded and consolidated are those that would also give rents or fissures, and fill them with metallic and mineral substances."

Mr. Wallace, the author of "The Laws which regulate the deposition of Lead Ore in Veins," is of the school of Werner, and he believes that he has determined certain laws regulating the formation of the metalliferous matter in veins. His positions take a most important form, and they should become the subjects of serious consideration to all who are interested in the expenditure of money in mining exploration. He proposes to lead the miner to such a knowledge of natural phenomena, as will enable him to say, from the position of a mineral vein, if it will be worth working. Whether Mr. Wallace's views be adopted or not, we believe there will be but few readers of his book who will not be struck by its logical character. From the 'Introduction' we glean that Mr. Wallace is a practical miner, engaged at the present time in carrying on important mining operations in Cumberland. He tells us "it has not been my lot to obtain the inestimable boon of a literary training;" and, again, he fears "the distraction of thought unavoidably caused by the performance of official duties, necessarily tends to render the style unequal, and the chain of ideas somewhat broken and disconnected, especially upon a difficult subject depending upon a long and intricate investigation, carried on in a locality where there is no assistance to be obtained from scientific libraries, or intercourse with scientific men."

We are disposed to think it fortunate that this thoughtful man has been so placed by Providence as to be compelled to look at nature, and read her "sermons in stones," without being brought under the disturbing influences of society.

The work commences with a careful examination of the geology of Alston Moor, which may be regarded as fairly representing the principal district in which deposits of lead occur.

The positions supported may be grouped thus:—

1. That Alston Moor consists, geologically, of a series of alternating strata of limestone, sandstone, and shale, and one layer of igneous rock.

2. That those strata are penetrated, or pierced through, by a considerable number of fissures, of which by far the greatest number have a main general direction, from the north of east to the south of west.

3. There are a few mineral veins which are locally called "cross veins," running nearly north and south.

4. The largest quantity of lead-ore has been found in the former, though the latter are not deficient of metalliferous ores; but whether in the former or in the latter, the lead is found in the limestone beds, not in the sandstone or shale. (A few remarkable exceptions occur in this and other lead producing districts, but the rule is as above stated, clearly pointing to some peculiar condition existing in the limestone rocks, which disposes the sulphide of lead to accumulate in them.)

Mr. Wallace is disposed to reject the commonly received idea, that the fissures were formed during the consolidation of the rocks through which they run:—"Sedimentary rocks have been consolidated under the bed of the ocean by immense pressure. A mass of clay consolidated under a pressure of some hundreds of thousands of pounds per square foot is not likely to contain many cracks or fissures." It is admitted that all the enormous masses of rock-formation, included within the carboniferous series, have been formed in the bed of the Old Red Sandstone ocean, and gradually upheaved to their present position, suffering during this uplifting,

an enormous amount of denudation. "The effect that would be produced by the removal of such pressure from extended sheets of hard rock is well worthy the attention of geologists," says Mr. Wallace, and he then clearly indicates his belief that small cracks or fissures have been formed during the mechanical process of upheaval, and the subsequent one of denudation, relieving the underlying rocks from pressure. These have been gradually enlarged by chemical and mechanical forces until they present their existing appearance.

(To be continued).

M. MOISSENET ON THE CORNISH METHODS OF DRAWING STUFF.

De l'Extraction dans les Mines du Cornwall. Puits inclinés et condés. Par M. L. Moissenet, Ingenieur des Mines. Paris: Dunod, Quai des Augustins, No. 49.

As a thoroughly reliable expositor of the mechanical operations of Cornish mining M. Moissenet is now so well known that any fresh contribution is necessarily regarded with considerable interest. When in addition the subject is one of such importance, and one on which opinions differ so widely, as the relative advantages of the various methods of drawing stuff in metallic mines, this interest is still further increased.

The most cursory perusal of this memoir (which occupies 118 pages of the *Annales des Mines*), shows that M. Moissenet has studied his subject with his usual zeal; and has consequently succeeded in bringing together the most complete mass of information that has yet been collected, and of deducing from this information practical conclusions of great importance. The vexed questions of skips and kibbles—wire ropes, hemp ropes, and chains—and the numerous other details connected with the economical drawing of stuff in metallic mines, are exhaustively discussed. Whatever may have been the original disadvantages with which M. Moissenet may have had to contend, as a foreigner, he has completely overcome them by his untiring energy, and the result is that his memoir is probably more valuable than if it had emanated from any one connected with Cornwall—for M. Moissenet being wholly unprepossessed for or against any of the existing methods his impartiality is beyond question.

We have prepared a full abstract of this memoir, but the pressure on our space obliges us to postpone it until our next number.

ON THE SALIFEROUS ROCKS AND SALT SPRINGS OF MICHIGAN.

By ALEXANDER WINCHELL.

(Abstracted from the *American Journal of Science and Arts*).

THE perfectly dish-shaped conformation of the strata of the lower peninsula of Michigan, has prevented the escape to the sea of such soluble substances as were originally embraced in the marine deposits from which the rocks were formed. Were there any point in the margin of one of these rocky basins, lower than its central portions, chance for escape of all its soluble contents would have existed; and it is doubtful whether in such case, brines could have been retained to the present day, in any considerable quantity. Our subterranean peninsular basins are comparable with the superficial basins in which the salt lakes of the world are located. Neither class of basins has an outlet. The basin of Lake Superior was once filled with water as salt as that of the Great Salt lake. Both have received accessions of fresh water; but while one has been drained by an efflux which has *continually carried* away some portions of the chlorid of sodium,

the other has been drained only by evaporation. The saliness of one has been reduced almost to an infinitesimal quantity*; that of the other is unimpaired, if it has not actually been strengthened by the loss of more water than it has received.

The subterranean basins of Michigan furnish us with three "great salt lakes." The principal one of these is shown, for the first time, in the "First Biennial Report" of the Geology of the State (1860), to occupy a position between the Carboniferous limestone and the sandstones at the base of the Carboniferous system—being on a parallel with the gypsiferous formation of Nova Scotia. It is a mass of argillaceous, gypseous, and pyritous shales, with thin beds of arenaceous and magnesian limestone, and beds of pure gypsum from 11 to 20 feet in thickness. The aggregate thickness is from 180 to 200 feet. Its outcrop describes an irregular circle, embracing the central portion of the peninsula. It underlies an area of 17,000 square miles, embracing the whole of nineteen counties, and at least half of sixteen others. This assemblage of strata, though probably included in the American representation of the Mountain Limestone of the Old World, has received the local designation of Michigan Salt Group.

Seven hundred and fifty feet below this is the Onondaga salt group, the circuit of whose outcrop is traced from Monroe county to Galt in Canada West, thence to Mackinac Island, Milwaukie and southward. The supply of brine in these strata has not been ascertained. They are well stocked with gypsum, and are known to be saliferous.

The third saliferous horizon has but recently been recognised. It was indeed known that brine of feeble strength exists in the coal measures, but only within a few days has it been proved that the salt wells at Bay City and vicinity on the Saginaw river, are supplied from this source. It *might* have been known from the first existence of these wells, if those having the boring in charge could have been induced to preserve specimens of the rocks. The Parma sandstone below the coal measures is the reservoir of this brine, as the Napoleon sandstone beneath the Michigan salt group is the reservoir of the brine from this group. It is now known that the Bay City wells terminated at the bottom of the Parma sandstone, though bored to nearly as great a depth as the wells of East Saginaw and vicinity, which pierce the Napoleon sandstone. This fact being established, a new well near Bay City has been sunk to a greater depth, and at 916 feet the Napoleon sandstone has been struck as predicted; and at the depth of 74 feet in this rock, brine has been brought up *completely saturated*. This occurrence, no less than the success of the first well bored in the valley, becomes a very gratifying confirmation of geological inferences drawn from observations extended over thousands of square miles, and in great part, hundreds of miles distant from the points where success has been attained.

When the first geological survey of the state was organized in 1837, Dr. Houghton, the superintendent, was instructed to direct his attention to the development of the "State salt springs." In pursuance of his investigations, and with the liberal co-operation of the legislature, he began in 1838, two salt wells—one three miles west of Grand Rapids, and the other in Midland county on the Tittabawassee river. The latter, after being

* Given the time required for the efflux through the Straits of St. Mary, of a volume of water equal to the usual contents of Lake Superior; given also the minute percentage of chlorid of sodium still remaining in the water of the lake; it is required to determine how long the processes of dilution through meteorological precipitation and drainage through the Straits must have been continued to reduce the sea-water which originally filled the lake basin to the degree of weakness which it has now attained: disregarding the chlorids derived from the *drainage waters* flowing into the lake.

prosecuted at intervals for four years, had reached the depth of only 139 feet when the work seems to have been obstructed by a "quartzose" boulder. The Grand Rapids well was sunk 473 feet, but without success. In the meantime Hon. Lucius Lyon, of Grand Rapids, sank a well 661 feet at a point further east; and obtaining water about one-fifth saturated, succeeded in manufacturing salt for a few years, at a time when salt was selling for 3 dollars per barrel.

The cause of these early failures is now apparent. Dr. Houghton entertained erroneous views of the structural geology of the peninsula. He expressed the opinion (Report, 1839, p. 9) that the strike of the rocks was north-east and south-west across the peninsula—that Saginaw Bay occupied a denuded space along the outcrop of "the sandstone" just where it comes in contact with "the limestone of the north"—that the coal on the Illinois river was on the strike of the coal-bearing rocks of Michigan—and the galeniferous limestone of Wisconsin and Illinois a prolongation of "a portion of the rock formation in the northern part" of Michigan. He further supposed that the brines of the State rose to the surface through fissures in the strata overlying the salt rock (Report, 1838, p. 21; also Special Report 1839, pp. 2 and 3), and that the geological position of the State wells on the Tittabawassee and Grand Rivers were about the same (Special Report, 1839, p. 6); while the latter was at least 360 feet below the former, and separated from it by the whole thickness of the coal measures (see also Hubbard's Geological Report 1841, pp. 132 *et seq.*)

It now appears that while the well on the Tittabawassee was located far within the salt basin, that on the Grand River was upon the thinning out edges of the strata. The brine at the latter point, as well as in Macomb and Washtenaw counties, is caused by a sort of exudation over the rim of this basin, and does not rise through fissures from a deeply-seated rock.

When it became apparent that the deepest portion of the great salt basin was probably beneath the neighbourhood of the confluence of the Cass, Shiawasse, and Tittabawassee rivers, a boring was commenced at East Saginaw, which at 742 feet had passed through the Coal measures, Carboniferous limestone and Napoleon sandstone, and afforded a plentiful supply of brine, nine-tenths saturated. This success was the signal for a general onset; and within two years twenty-three wells have been bored along the valley of the Saginaw, and new ones are continually undertaken.

The following is an average section of the rocks passed through in the borings in the vicinity of East Saginaw :—

Alluvial and Drift materials	100	feet
"Woodville sandstone," brown and coarse	65	„
Coal measures, consisting of shales with some sandstones and limestones and coal	130	„
"Parma sandstone," white and porous	115	„
Carboniferous limestone, often highly arenaceous; generally so below	75	„
"Michigan Salt Group"	170	„
"Napoleon sandstone," light buff, rather coarse and porous	110	„
Total	765	„

The Napoleon sandstone is underlaid by a red shale which has been pierced 64 feet.

From East Saginaw the depth of the wells increases southward, towards the centre of the general basin; and also northward, so that in the vicinity of Bay City the bottom of the Napoleon sandstone is found at the depth of 1,000 feet. We seem, *therefore, to* have a local basin towards the mouth of

the Saginaw river, although the vicinity is 10 or 15 miles nearer the outcropping margin of the salt basin, which is found at the mouth of the Pigeon river and in Tawas bay, on opposite shores of Saginaw bay.* This local basin is filled by an extraordinary thickening of the shales of the Coal measures, almost exclusively. As the Parma sandstone, which furnishes the brine of the first wells at Bay City, is probably the equivalent of the saliferous "Conglomerate" of Ohio, it seems that the supply of brine at this horizon, bears a relation to the thickness of the overlying shales of the Coal measures. It also suggests that in the deeper portions of the general basin, the Coal measures must be found similarly augmented in thickness, and the Parma sandstone similarly charged with brine. This condition should be looked for, west and north-west into Gratiat and Midland counties.

The following are analyses of Saginaw Valley brines. The first is by Professor Du Bois, of the University of Michigan, from the Napoleon sandstone; the second by Jas. R. Chilton and Co., from the Parma sandstone:—

	Saginaw City.	Bay City.
Specific gravity	1·180	1·163
Chlorid of sodium	19·246	19·692
„ calcium	2·395	0·742
„ magnesium	1·804	0·482
„ potassium	0·127	—
Sulphate of lime	0·534	0·145
„ soda	—	0·116
Bromid of magnesium	—	0·013
Compounds of iron	0·064	—
Total solid matter.. ..	24·170	21·140

The difference in the composition of these brines is in accordance with their difference of origin.

The average supply of the Saginaw wells is at least 25,000 gallons each, in twenty-four hours.

The creation of this new branch of local industry is destined to become a matter of very great general importance. Although but two years have elapsed since the production of the first bushel of salt in the Saginaw Valley, there are now (Aug. 1st) no less than twenty-two blocks of kettles in actual operation, turning out 1,210 barrels of salt per day, or, making an allowance for the effect of winter weather, 1,980,000 bushels per year. Here is a growth, at the end of two years, equal to that attained by the Onondaga Salt Works in 1834, at the end of 38 years after the salt springs passed under the superintendence of the State. In two months seven more blocks will come into operation, increasing by nearly one-third the foregoing figures.

Such is the strength and abundance of the brine and cheapness of fuel, that a barrel of salt is made at a cost of 64 cents. The cost of a barrel at Syracuse is at least 95 cents, so that Saginaw salt would pay the manufacturer 48 per cent. of profit if the price were put down to the prime cost of the article at Syracuse. Moreover the quality of the article has proved so superior, that the market is actually clamorous for an adequate supply.

When we consider the cheapness and quality of Saginaw salt, the inexhaustibleness of the supply of brine and the excellent facilities for shipment, it would appear that there is little danger of over estimating the future development of this new resource.

On page 72, vol. i, Geolog. Rep. Wisconsin, Professor Hall states, undoubtedly through inadvertence, that the "Hamilton group is known upon Saginaw Bay." The Hamilton group strikes the lake shores in Thunder and Little Traverse Bays many miles further north.

Notes and Memoranda.

Sir Roderick I. Murchison, K.C.B.—The Queen has been graciously pleased to give orders for the appointment of Sir Roderick Impey Murchison, Knight, Director-General of the Geological Survey of the United Kingdom, and Director of the Royal School of Mines and Museum of Practical Geology, to be an Ordinary Member of the Civil Division of the Second Class, or Knights Commanders, of the Most Honourable Order of the Bath.

Mineral Veins.—A lecture on this subject was delivered at a meeting of the Glasgow Geological Society, Thursday, January 29th, by James Napier, Esq., sen., F.C.S. The lecturer went into various details of Cornish mines, showing that no general law has yet been found for the production of veins, and that the apparent law in one locality cannot be applied safely in the search for veins of a similar kind in another; and then went on to consider the various theories of Phillips, Dr. Collyer, M. Agassiz, Mr. Moore, Mr. Jukes, Sir Charles Lyell, Mr. Sorby, &c., and referred to the interesting experiments of Mr. Robert Were Fox; concluding by saying that, before any general theory can be formed of their origin, there must be much more minute observations made upon the *whole contents* of a vein, physically and chemically. When this is done, then geologists may venture upon a theory for the filling of veins, and be able to show how one part of a vein is rich in one kind of mineral, and another part of the same vein in another sort of mineral entirely different in every sense.

The Hartley Relief Fund.—In the *Times* of February 3rd a letter appeared in leading type signed "Vox Populi," enquiring what had become of the surplus of the noble sum of £70,000, subscribed to the Hartley relief —of which not more than £30,000 was required for distribution among the sufferers; and asking why the surplus should not be applied to relieving the sufferers by the Edmund's Main explosion. "The money," says the writer, "was not given because the accident occurred in Northumberland; county distinction never entered into the heads of the donors. Then why, out of the superabundance, should not something have been granted to Yorkshire?" The secretary of the fund, Mr. John Atkinson, of Newcastle-on-Tyne, replied that £70,000 was invested in securities; £5,500 was at the bankers; and about £5,500 had been already distributed. Before dealing with any portion of the assumed surplus, he stated that the committee were waiting a report from an actuary. Since then the report of the actuary, Mr. W. F. Birkmyre, has been received, which shows that a sum of 35,252*l.* 11*s.* 3*d.* will be required to be invested to provide for the allowances for the next fifteen years, and a further sum of 15,176*l.* 14*s.* 9*d.* after that period—making a total of 50,429*l.* 6*s.* 0*d.*; so that there remains a surplus of nearly 25,000*l.*, with respect to the distribution of which the committee will probably make a recommendation to the subscribers.—It is obvious that the impatience of certain persons in this matter has been most unreasonable; and that it was impossible for the committee to assume—much less deal with—any surplus, until the charges on the fund had been accurately determined.

Miners' Association of Cornwall and Devon.—A meeting of this association was held at Redruth on Tuesday the 3rd, when Mr. Charles Fox, the president for the past year, delivered a long and interesting address. Mr. John Francis Basset, of Tehidy, was elected president for the ensuing year. Of any landed proprietor in Cornwall Mr. Basset receives by

far the largest amount of dues, being lord of Dolcoath, Cook's Kitchen, Carn Brea, East Pool, West Seton, Wheal Basset, South Frances, West Basset, South Basset, North Basset, and several other mines. Since Mr. Basset's election he has issued a circular convening a meeting, to be held at Camborne on March 2nd, "to take into consideration the best means of improving the funds of the association, and also to receive any suggestions for the carrying on the association in a more effectual manner."

COTTA'S "GESTEINSLEHRE."—Professor Cotta has addressed a communication to the *Berg-und-Hüttenmännische Zeitung* stating that the new edition of his "Gesteinslehre," the well-known standard work of reference on rocks, which will shortly be published, will be almost an entirely new work, scarcely a word remaining unaltered.

NORTH OF ENGLAND INSTITUTE OF MINING ENGINEERS.—A meeting of the members of the institute was held on Thursday, February 12th, the president, Mr. N. Wood, in the chair. An interesting paper was read by Mr. Atkinson, Government Inspector of Mines, "On the Mode of Ventilating Prussian Mines." Mr. Lindsay Wood also read a paper on the "Coal-Cutting Machine," giving an account of the performance of the coal-cutting machine introduced at the West Ardsley colliery, near Leeds.

MANCHESTER GEOLOGICAL SOCIETY.—At the monthly meeting of members on Tuesday, January 27th—the president, Mr. Joseph Dickinson, in the chair—Mr. John Taylor, jun., read a paper on "The Cambrian Strata of the Isle of Man." The paper was based on the discovery of several fossils in the solid rock of the Cambrian formation. A discussion which followed the reading of the paper led to lengthened observations on the highly interesting experiments of Sir James Hall, Mr. Gregory Watt, and Mr. Sorby, on the formation of granite and crystals.—A paper on "The Edmund's Main Colliery Explosion," was read by Mr. T. Farrimond. In the course of a brief discussion which followed, Mr. Goodwin said that he objected strongly to the continual bringing forward of the name of George Lawton, the steward, and speaking of his incompetence, so long as he had paid the penalty of death. He said that he must also strongly object to the reading of a paper on a subject like that, before the termination of the coroner's inquiry. He had had many years' experience in the working of collieries, and he had been induced to give a full and careful examination to the circumstances attending this explosion, and the conclusion he had come to was that this colliery was worked better than many which were generally considered to be worked well.—The Chairman asked whether Mr. Goodwin, as an experienced colliery manager, sanctioned the use of a mixture of safety-lamps and naked lights?—Mr. Goodwin replied that he did not; nor should he have used them in this colliery, considering the quantities of gas that surrounded the workings. So far as the workings themselves were concerned, he believed that they generated very little gas, and the proof of that was to be found in the fact that the colliery was wholly, or nearly wholly, worked with the naked candle. He expressed his surprise that Mr. Farrimond, who a short time ago advocated the pillar and stall system, should now condemn it.—Mr. Farrimond said that he was in favour of the wide-work system. Experience had taught him that by adopting it coal could be worked cheaper, and mines could be better ventilated.—In reply to an observation from Mr. Binny, who strongly condemned the use of mixed lights, Mr. Goodwin said that he would sooner take the candle, with all its defects, than the Davy lamp. He would not say that it was safe in the hands of every one, but with careful management it would be better than many people suppose.

NEW GUN-METAL.—A correspondent of the *Times* under the signature of Y describes a new alloy proposed to be employed as a material for guns,

designated sterro-metal, from the Greek word signifying "firm." It consists of copper and spelter, with small proportions of iron and tin, and to these latter its peculiar properties are attributed. It has a brass yellow colour, is close in grain, is free from porosity, and has considerable hardness, whereby it is well adapted for bearing-metal, or other purposes where resistance to friction is needed. The mechanical properties of the alloy have been carefully examined at the Polytechnic Institution, Vienna, in the presence of competent observers, and from a duly attested copy of the tabulated results of not fewer than thirty of these experiments, the following facts are stated:—The tensile strength of sterro-metal, after simple fusion, is 27 tons; ditto, after forging red-hot, 34 tons; ditto, drawn cold, 38 tons; gun-metal, after simple fusion, 18 tons. The same copper, from Boston, United States, was used in making both the sterro-metal and the gun-metal, and for the latter the best English tin was employed. Both alloys were cast under precisely similar conditions and run into the same mould. Similar results were attained with trials made at the Arsenal, Vienna. The specimens of metal operated on in the preceding experiments were analysed at the Austrian Mint. The results are as under:—

	Polytechnic Metal.	Arsenal Metal.
Copper	55·04	57·63
Spelter	42·36	40·22
Iron	1·77	1·86
Tin	3·83	0·15
	100·00	99·86

Experience has shown that the proportion of spelter may vary from 38 to 42 per cent. without materially affecting the quality of the alloy. The difference in the amount of tin in these analyses is considerable, and greater than might have been expected. The specific gravity of the forged metal is 8·37, and that of the same metal drawn cold into wire 8·40. The hardness of the cast metal is stated somewhat to exceed that of ordinary gun-metal, and to increase by forging. The great tensile strength of sterro-metal as compared with gun-metal is remarkable. Mr. Anderson gives only 17 tons as the average tensile strength of the best specimens of gun-metal tested at the Arsenal, Woolwich, and about 26 tons as the average tenacity of wrought-iron in bar, such as is employed at Woolwich in the manufacture of the Armstrong gun, and about 35 tons as the average tenacity of the strongest kinds of steel which have withstood the Woolwich proof rounds. But sterro-metal possesses another quality—namely great elasticity. It is not permanently elongated until stretched beyond 1-600th of its length; but within that limit it is perfectly elastic, and recovers its original form after the stretching force is withdrawn. Gun-metal is permanently elongated when stretched beyond 1-1590th of its length, and wrought-iron beyond about 1-1500th of its length. The inventor proposes that in heavy ordnance the interior should consist of a tube of sterro-metal, and that over this wrought or cast-iron should be shrunk from the breech to beyond the trunnions. Sterro-metal, it should be stated, is from 35 to 40 per cent. cheaper than gun-metal.

Metallic Mines Commission.—The Hon. E. F. Leveson Gower, M.P., and Sir Philip de Malpas Grey Egerton, M.P., have been placed on the Commission to inquire into the condition of all mines in Great Britain to which the provisions of the Act 23rd and 24th Vict., cap. 151, do not apply with reference to the health and safety of persons employed in such mines —in place of the Hon. Algernon Fulke Egerton, M.P., and Mr. Henry Austin Bruce, M.P., who have resigned, being prevented by other duties from attending the meetings of the Commissioners.

Mining, Quarrying, and Metallurgical Review.

WESTERN COUNTIES.

Those interested in Cornish copper mining have been much disheartened by the recent continuous and heavy fall in the standard. For the last four sales the standard has fallen upwards of 8*l.*; and including the previous sale of January 29th, the total fall, during the five weeks, has been about 11*l.* 10*s.* Such a decline as this, although not absolutely unprecedented, is one of a very unusual character, and must seriously affect all large producing mines.

Last month we referred to the dissolution of partnership between Messrs. Tweedy, Williams and Co., of the Cornish Bank, and Mr. John Michael Williams, and the abandonment of the business of the Redruth branch to the latter gentleman, now carried on as the West Cornwall Bank. We also mentioned the excitement and angry feeling among the customers of the bank resulting from the circumstances under which this arrangement had been brought about. This feeling has been so general, that a large number of the accounts kept at the Redruth branch, and which consequently, as a matter of course, would have passed with the business of that branch to the new firm, have been removed to the banking establishments of the old firm at Truro and Falmouth. At Clifford amalgamated meeting (on the 18th) there was a stand-up fight for the account between the partisans of the old and new firms, both of whom were largely interested. It ended, however, in the discomfiture of Mr. J. M. Williams's friends by a majority of 1,031 to 812—a result which fairly indicates the balance of opinion in the district. But the victory of Messrs. Tweedy's friends was even greater than these figures show, for while Mr. J. M. Williams voted on all his shares, neither Mr. William Williams, nor his son Mr. Fred. Martin Williams, who are still partners with Messrs. Tweedy in the old firm, and who represents an additional 478 shares, had any occasion to vote. Mr. Richard Davey, M.P., who was Mr. J. M. Williams's principal supporter, resigned his position as a member of the committee and joint treasurer.

At *Wheal Harriett* account (January 26) it was resolved that 25 guineas should be set apart to purchase a testimonial for Captain Williams; and that the inspection of the mine be limited to Saturday in each week.—At *Prosper United* special meeting (January 28) the resignation of Captain Thomas Richards was accepted. At *Old Wheal Neptune* meeting (Feb. 12) it was resolved that the nominal capital of the company be increased to 25,000*l.* by the creation of 4,000 new shares of 2*l.* 10*s.* each to be offered *pro rata* to existing shareholders.—At *St. Day United* meeting (Feb. 12) a resolution was passed authorising the secretary to petition the Stannaries Court against shareholders in arrear of call.—At *Great Alfred Consols'* meeting (Feb. 11) it was resolved that the best thanks be given to the committee for their past services, and that they be requested to wind up the affairs of the adventure at the earliest possible period. Captain John Secombe has been appointed manager and local purser of *East Jane* mine.—At *Wheal Par*, a new tin mine near St. Blazey, twelve heads of steam-stamps have been put to work.

A concern called *St. Just Consols* is advertised, under the promotion of the same party as St. Just United was started. The mine is in the St. Just district.

A prospectus has also been issued of *South Buller* mine in the Tresavean district. The company is a London one.

WALES AND THE BORDERS.

South Wales.—The iron trade in this district is still in a satisfactory state, and although there has not been quite such an active demand for

bars and rails as during last month, most of the large works are doing a fair amount of business. In some districts preparations are being made for doing a more extensive trade, and furnaces which have long been idle are being re-lighted. The Varteg Works have been taken by Messrs. Jones and Partridge, and it is said that operations will shortly be commenced upon a somewhat extensive scale, giving employment to several hundred hands.

At the Dowlais Works (which are by far the largest in South Wales), considerable activity has been manifested, and there are at present between 8,000 and 9,000 persons engaged there. For the last month or two these extensive works have been well occupied with new orders received both from home merchants and continental states, and although the prices are low, yet they are somewhat in advance of those received three months back. The same applies to the other large works in the district, and it appears probable that an advance in prices will be made before long. The Spanish, Russian, and other continental states continue to be the best customers, but American orders are on the increase. At Ebbw Vale, the works are undergoing a thorough renovation. Extensive workshops have recently been erected, and a new furnace will soon be ready for lighting.

The coal trade has not shown any great amount of activity, although on the whole the colliers have been fairly employed. The general complaint lately has been the scarcity of vessels to take the coal away, but the present fine weather will remedy this. Several new collieries are being opened in the Ely Valley, the produce of which will be shipped at Cardiff. The Machen Company are proceeding energetically with their new pit at Bedwas. The Fforchamman Colliery, near Aberdare, where such a vast capital has been laid out, is being gradually brought into working order, and the present management bids fair to make it a good paying property. A company is being organised by a local gentleman of influence, for the purpose of working the Brynna Collieries, near Bridgend. Hitherto this property, as well as nearly all the "pitch" veins of the neighbourhood, have not proved such good paying speculations as might be desired and expected. The Trimsaran property has been purchased by a spirited company, and operations will be commenced without delay.

The shipping returns for January show that Cardiff still maintains the lead. The number of ships that cleared during the month was 301; the total amount of coal shipped was 103,006 tons, and of iron 9,528 tons, against 101,024 tons of coal, and 8,416 tons of iron in the corresponding month of 1862, showing an increase of 1,982 tons of coal, and 1,112 tons of iron.

The returns from Swansea show a large falling off in every branch of shipping. The number of vessels entering the port was 332, with an aggregate registered tonnage of 43,658 tons, the number for the corresponding month of 1862 being 467 ships, of 57,457 tons, a decrease during the past month, as compared with the corresponding period of last year, of 135 ships, and 13,799 tons. The coasting and continental trades have suffered most severely, the deficiency in these two departments amounting to about 11,000 tons, as compared with the corresponding month of last year.

Neath and Llanelly also have fallen off, chiefly in the coasting trade.

Among new companies advertised since our last is the *Powell United Silver Lead Mining Company*, with a capital of 10,000*l*., in shares of 5*l*. each. The mines are near Aberystwith, and have been favourably reported on by several agents.

The *Iron Lead Mining Company* has issued its prospectus, with a capital of 10,000*l*., in shares of 5*l*. each. This Company proposes to work a property between Milwr and Holway.

GLOUCESTERSHIRE.—The imports into Bristol during the past month include: 360 tons of pig-iron from Glasgow and Belfast; 220 tons of sulphur from Pomaron; 19 casks of metal from Rotterdam. Among the exports

have been 632 tons of coal. The Customs' duties received during the month of January amounted to £80,138 2*s.* 11*d.* The Town Council of Bristol, who are the proprietors of the docks at that port, and conservators of the River Avon, have determined to apply for powers, in the present session of Parliament, to expend £400,000 in the improvement of the river and harbour. The works will comprise, the widening, deepening, and straightening the River Avon, and the provision of additional quay berths in the floating harbour. A large increase of trade is expected to follow these improvements, and this movement, taken in connection with the proposed ocean docks at the mouth of the Avon, cannot fail to attract to the port a larger class of sailing vessels and steam-ships than have hitherto traded there, and a beneficial influence in the coal and iron trades of the district will be the natural consequence.

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—A gradual though slow improvement is taking place in the state of trade in this district, the iron trade especially is healthy. Iron shipbuilding is going on briskly upon the Tyne, and among the latest novelties in this line are two tank ships in the course of construction at the St. Peter's shipbuilding-yard, intended to be employed in conveying petroleum from America.

The mild weather has been very detrimental to the coal trade, and many collieries have only been making three or four days a-week.

It is stated that a number of blast-furnaces are about to be erected in the Cleveland district. The following is the state of the blast-furnaces of this district on February 4th of this year. This return shows the largest number of furnaces in blast ever recorded.

Place and Owners.	In.	Out.	Total.
Elston—Bolckow and Vaughan	9	—	9
„ Clay-lane Company	3	—	3
„ Samuelson and Co...	3	—	3
Cargo Fleet—Jones, Dunning and Co.	2	—	2
„ Cochrane and Co.	4	—	4
„ Gilkes, Wilson, Pearse and Co. ..	4	1	5
Middlesbro'—Bolckow and Vaughan	2	1	3
„ Hopkins and Co.	2	—	2
Port Clarence—Bell Brothers	5	1	6
Norton—Warner, Lucas and Barret	3	—	3
Stockton—Holdsworth and Co.	3	—	3
Thornaby—W. Whitwell and Co.	2	1	3
Darlington—South Durham Company	2	1	3
Ferryhill—Morrison	3	—	3
Witton Park—Bolckow and Vaughan	4	—	4
Stanhope—Weardale Iron Company	—	1	1
Towlaw—Weardale Iron Company..	4	1	5
Consett—Derwent Iron Company	5	13	18
Total	60	20	80

The exports from the Tyne comprise: 63,642 tons of coal; 14,985 tons of coke; 31,054 cwts. of iron; cargoes of pyrites from Pomaron and Antwerp; 14,000 bars of lead and some iron-ore from Carthagena; bars of lead from Almeira; iron-ore from Lines; manganese from Garrucha; and a cargo of pit props and battens from Christiansand.

MIDLAND COUNTIES.

STAFFORDSHIRE AND WARWICKSHIRE.—The iron trade in this district in the early part of the month, was not so active as might have been expected at this season of the year, orders having been much slower in coming in than was anticipated. Things improved, however, towards the end of the month, a good many orders having been received from America. In sheets the trade is characterised by considerable briskness, and upon the demand an appreciable and enlivening influence has been exercised by Russian purchasers. The coal trade continues good, but there is a great want of workmen. The demand is especially good for coal for manufacturing purposes, and proprietors who have thick-coal at collieries within an easy distance of the leading works are very busy. A brisk trade is being done in iron-stone of good quality, and increased prices are obtained.

DERBYSHIRE.—The position of the iron trade is improved, business is conducted cautiously, and there is but little speculation. There is a moderate enquiry for bars, and rates are well maintained. The coal trade is scarcely so active as it was; the demand for London has fallen off; and there is less enquiry for other markets.

SCOTLAND.

The pig-iron market has been depressed, and the shipments show a considerable diminution compared with those of the same period last year. The shipments altogether this year show a considerable decrease. During the first weeks of the last four years the exports have been as follows:—

	1863.	1862.	1861.	1860.
	Tons.	Tons.	Tons.	Tons.
Jan. 3.. ..	5,973	7,707	5,202	4,812
„ 10.. ..	6,520	8,882	7,280	7,478
„ 17.. ..	7,203	9,308	9,266	10,374
„ 24.. ..	6,102	8,915	9,771	9,790
„ 31.. ..	4,609	9,917	7,748	6,171

We thus arrive at a total of 30,467 tons for the present year, against 44,729 tons in the corresponding period of 1862, 39,267 tons in the corresponding period of 1861, and 38,635 tons in the corresponding period of 1860. The export business of the present year has consequently been smaller thus far than in any of the previous periods under notice. It is to be feared that less business has been done this year with France than was effected in January, 1862, when the commercial treaty was invested with the attraction of novelty.

Coals have been in moderate request for home use and for shipment.

THE CONTINENT.

FRANCE.—The demand for copper at Paris has been very dull, and prices have undergone a marked reduction. Tough cake has been quoted at 90*l.*; Lake Superior, 107*l.*; Chilian 87*l.* In the Haute-Marne district, prices have been almost nominal; pig has been quoted at 5*l.* 12*s.*

The following interesting statistics respecting the coal and iron production of France, are taken from a letter signed J. K. B., in the *Times* of February 4th.

Coal.—The production of coal in France was, in 1859, 7,500,000 tons; 1860, 8,039,168 tons; 1861, 8,400,000 tons; 1862, 9,400,000 tons. The price of coal at the pit's mouth was, in 1860, 9*s.* 1½*d.* per ton; 1861, 9*s.* 1½*d.* per ton; 1862, 9*s.* 0½*d.* per ton.

Notwithstanding the rapid increase in the production of coal in France, it will be observed that it amounts to one-tenth only of the quantity yielded by the mines of Great Britain.

Iron.—The production of pig and cast-iron in France was, in 1862:—smelted with charcoal, 285,000 tons; value, 1,949,200*l.*; per ton, 6*l.* 16*s.* 9*d.* With coke, or coke and charcoal mixed, 768,000 tons; value, 3,456,000*l.*; per ton, 4*l.* 10*s.* Total of all qualities in 1862, 1,053,000 tons: value, 5,405,200*l.*

The production of pig and cast-iron was, in 1861: smelted with charcoal, 298,000 tons; with coke, or coke and charcoal mixed, 590,000 tons. Total of all qualities in 1861, 880,000 tons.

The total production of all descriptions of pig and cast iron was, in 1859, 856,152 tons, and the total in 1862 having been 1,053,000 tons, it appears that there has been an increase in the total production in France during three years of nearly 25 per cent.

The quantity of bar and other descriptions of wrought iron manufactured in France was, in 1862, with charcoal, 71,100 tons; value, 1,194,800*l.*; per ton, 16*l.* 16*s.* 1*d.*; with charcoal and coke mixed, 29,400 tons; value, 404,000*l.*; per ton, 13*l.* 14*s.* 10*d.*; with coal, 600,000 tons; value, 5,724,000*l.*; per ton, 9*l.* 10*s.* 9*d.* The total of all descriptions of bar and wrought iron manufactured was, therefore, in 1862, 700,500 tons; value, 7,322,800*l.*

The quantities manufactured were, in 1861, with charcoal, 76,600 tons; with charcoal and coke, 32,400 tons; with coal 493,700 tons. The total quantity manufactured in 1861 was, therefore, 602,700 tons.

The quantities manufactured were, in 1859, with charcoal, 90,660 tons; with charcoal and coke, 16,930 tons; with coal, 412,510 tons. The total quantity manufactured in 1859 was, therefore, 520,000 tons; and the total manufactured in 1862 having been 700,500 tons, it appears that there has been an increase in the total production in France during three years of 180,500 tons, or more than 33 per cent.

The quantities of British iron imported into France during the first eleven months of 1862 were: pig-iron, 149,551 tons; bar-iron and rails, 41,565; plates, sheets, and tin-plates, 2,650; all other descriptions, 7,023 tons.

It is impossible to examine the foregoing returns without being struck not only by the rapid increase in the production and consumption of iron in France, but also by the extreme smallness of the importations from Great Britain, the largest and cheapest producer of iron in the world.

The annual production of pig-iron in Great Britain now amounts to 4,000,000 tons, of which 2,500,000 tons are manufactured into bars, rails, plates, sheets, and other descriptions of wrought iron.

The prices of iron are comparatively high in France. The returns from which the foregoing particulars have been abstracted state them to have been higher for similar descriptions in 1862 than in 1861.

In Great Britain the very low prices of the last five years fell still lower in 1862.

The importations of British iron into France scarcely amount to 5 per cent. of the total production of Great Britain.

It is evident, therefore, that with regard to one, at least, of the most important branches of British industry, the recent treaty of commerce is not based on sufficiently equitable principles.

BELGIUM.—With the exception of rails, the Belgian iron market has not been very active. In the Liege Basin, ordinary pig-iron has realised 2*l.* 14*s.* to 2*l.* 16*s.* per ton. At Charleroi, the various descriptions of pig have been quoted as follows:—inferior qualities, 2*l.* 16*s.*; mixed, 3*l.*; strong hard iron, 3*l.* 2*s.*; and grey and superior, 3*l.* 12*s.* per ton. Plates have been in good demand. A new and very complete rolling-works was put in operation during January, at Marchienne.

AMERICA.

COAL PRODUCT OF THE UNITED STATES.—The revised statistics show that there was produced in the United States during 1860, the last year of peace in the Union, 9,416,332 tons of anthracite, and 6,185,246 tons of bituminous = 15,601,578 tons. The value of this was nearly treble that raised in 1850. The anthracite district of Pennsylvania produced 8,300,936 tons in 1860; 7,673,834 tons in 1861, and 7,771,737 tons in 1862. In consequence of the war the complete statistics for 1862 are not ascertained.

NICKEL, ZINC, AND COPPER MINED IN THE UNITED STATES IN 1860.—Statistics of nickel, zinc, and copper mined in the United States during the year ending June 1, 1860, copied from the preliminary report on the eighth census:—

State.	Nickel.		Zinc.		Copper.	
	Tons of ore.	Value.	Tons of ore.	Value.	Tons of ore.	Value.
		Dollars.		Dollars.		Dollars.
Pennsylvania ..	2,348	28,176	11,800	72,600	70	2,450
Maryland	—	—	—	—	1,500	60,000
Michigan	—	—	—	—	6,283	2,292,186
Missouri	—	—	—	—	50	6,000
Virginia	—	—	—	—	1,500	31,880
N. Carolina ..	—	—	—	—	2,000	105,000
Tennessee	—	—	—	—	2,379	404,000
N. Mexico	—	—	—	—	650	415,000
Total ..	2,348	28,176	11,800	72,600	14,432	3,316,516

PATENTS RELATING TO MINING AND METALLURGY.

CEMENTATION OF IRON.—Letters patent have been granted to M. Lamiable, of Paris (No. 1,484) for "improvements in cementing cast and wrought iron to obtain cast steel." The patentee places cast or wrought iron in a sheet iron box, with sawdust, and then lutes the joints of the box with clay; he places the whole in a moderately intense fire during a length of time, varying, according to the thickness of the pieces. The steel obtained is placed in a crucible with fresh sawdust, being closed, and heated until the metal is melted; which is then poured into a mould, good cast steel being then obtained. The mould should be dry, and in certain cases raised to a high temperature.

SMELTING (BLAST) FURNACES.—Letters patent have been granted to Mr. Tate (No. 1,380) for "improvements in smelting furnaces;" being a communication by Wlademer Raschette, of the mining department, St. Petersburg. Smelting furnaces are usually of a circular form, and of great height, to afford the necessary capacity, and with generally one, or more twyer holes for the introduction of the blast. In circular furnaces, the blast has a long way to penetrate the heated mass, and does not penetrate equally through it. In this invention the horizontal section of the interior is of a rectangular form, at any point of its height. The lengthened form of the parallelogram is such that two sides of the furnace are of considerable width, and near to each other, at which sides he introduces the twyers, a series of some twelve or thirteen are so arranged as not to be directly opposite each other. In the ends of the parallelogram constituting the ends of the furnace, he disposes the apertures for drawing off the metal. By this arrangement of the furnace and the twyers, the blast readily and thoroughly permeates the mass. The furnace is made of the smallest area below where the

blast is introduced, but increases upwards to a considerable extent, and the sole is inclined towards the outlet apertures for the metal. Instead of introducing the blast by a series of twyers disposed at intervals along the sides of the furnace, he forms the apertures of the blast so as to introduce it in the form of a thin film, extending along the whole length of the sides of the furnace.

PUDDLING FURNACES.—Messrs. Hill, of Abergavenny and Caddick, of Ebbw Vale (No. 1,502), have obtained provisional protection for "improvements in puddling furnaces;" and according to this invention, the iron bottom or bed of the hearth and the arched roof over it, are supported on iron columns in the following manner:—The bed is supported on short columns ranged around the outer edge; on the top of these a metal frame rests. This frame is open in the centre, and the outer edge of it is of the same shape as the bottom of the hearth. Across the opening in the centre of the frame bars are placed, which support the metal plates forming the bed. The sides of the hearth are formed with broad flanges, upon which the arched roof is supported. These flanges also rest on iron columns, placed at intervals along the side of the hearth and longer than the columns which support the bed. In order to be able to cool the bottom and the sides and ends of the hearth when desired, arrangements are made for directing jets of water against them, through the ends and under the bottoms of the furnace and of the hearth. The bottom of the puddling furnace is constructed of wrought iron plate, riveted together, the sides of each plate forming the bottom being bent down so as to form flanges, which are inserted into wrought-iron troughs. The waste heat from the furnace may heat a boiler, by causing the flue from the end of the furnace to rise up vertically for a short distance, where is placed an oblong boiler, a space being left between the interior of the flue and the exterior of the boiler. The heated gases from the furnace pass up around the boiler, and are led away into a chimney by another flue, which opens into one side of the vertical flue.

MINERS' SAFETY LAMPS.—Mr. Hall, of Birmingham (No. 1,671), has obtained provisional protection for "improvements in miners' lamps." This lamp consists of a Davy fitted with a spring lock and superior wire gauze. The spring lock contains a bolt which springs into a hole made to receive it in the body of the lamp, and cannot be withdrawn, without the aid of a key made for the purpose. The bolt is fitted with a collar which prevents it from springing out of its place, by means of a nozzle, which serves also as a guide to the key, and a guard to prevent the lock being picked. Between the collar and the nozzle there is a coil spring. The inner end of the bolt is sloped as a sliding latch, which slides in a groove in the base of lamp while the two portions are being screwed together, until it arrives at the hole made to receive it. The nozzle has a flat upon it, which fits tightly against the body of the lamp, so that it cannot be unscrewed without first withdrawing the bolt and removing the base from lamp-body. The "superior wire gauze" is made by tinning or galvanizing the ordinary gauze, thereby soldering and strengthening the seams.

VENTILATING MINES.—Letters patent have been granted to M. F. Giachosa, Warwick, (No. 1,721), for "improvements in ventilating mines, &c." The object of which is to facilitate the removal of carbonic and other deleterious gases or vapours. For this purpose a series of chambers is employed, formed by covers and partitions, the surfaces of which are connected by cylinders of leather or other flexible material to a bell-mouthed collector, adapted to collect or admit of the flow of the gases from the lowest surface where such apparatus is applied; motion is given by suitable mechanism.

MACHINERY FOR WORKING BORING AND MINING TOOLS.—Mr. G. Simpson, of Glasgow (No. 1,831), has been granted letters patent for improvements in machinery for working boring and mining, or excavating tools, and mine and other pumps." This invention relates to improvements and modifications in such machinery, described in the specification of November 9th, 1861, where the boring bars are attached to a piston working in a steam cylinder. By the present invention the piston is provided with an enlarged piston-rod or trunk, for the purpose of reducing its area on the under side, whereby an excess of pressure is obtained on the top of the piston to assist in the descent of the bars when necessary, the under

part of this piston is always in communication with the boiler, the steam acting thereon as a partial cushion during the down-stroke, and returning it back with the boring bars when the steam is allowed to escape from the top. A steam cylinder working similarly to the one for boring, is arranged to impart a reciprocating motion to a ram fixed on the piston rod, and fitted with a series of chisels. These chisels are arranged to project in steps, so that a transverse movement being made between the strokes, each chisel strikes on a place previously struck by its shorter neighbour, the cut is thus gradually driven in to the depth of the longest chisel. The cylinder is mounted on a frame, and is moved along the face on wheels or slides, either by hand by means of a screw, or by a ratchet or rack movement worked by the piston. If racks or slides are used, they are fixed in position in the mine by screws jamming in between the roof and floor. The same arrangement of direct acting steam cylinder is adapted to mine pumps. In all these applications, it is an important feature of the system of working, that the reciprocation is due entirely to the alternate admitting and letting off of the steam from one side only of the piston or pistons, a uniform pressure being constantly maintained on the other side, acting as a cushion to counteract the weight of rods.

Blast Furnaces.—Letters patent have been granted to Mr. Brooman, Fleet-street (1,917), for "improvements in the construction of blast furnaces." The object of this invention is to enable the lower portions of blast furnaces, and those subjected to most wear, to be removed when necessary and replaced by similar and duplicate portions, without materially interfering with the working. The invention consists; first, in the construction of blast furnaces in two parts, one part being fixed and the other moveable; secondly, in the employment of a trough extending round the furnace in the thickness of the wall, for containing water, air, or other cooling agent, in order to prevent any adhesion of the parts at the point of junction; and thirdly, in the employment of sight holes in the lower part of the boshes and side of the crucible, by which the state of wear of those parts may be viewed. When it is necessary to remove the moveable portion, bars are inserted through apertures, for the purpose of supporting the contents of the upper part of the furnace, and prior to their insertion the temperature should be reduced at the points of insertion, by injecting cold water or air. This done, all the furnace below the trough is lowered, until the wheels upon which it is supported rests on rails laid to receive them; it is then run away, and a similar portion of furnace previously charged and heated is rolled in to take its place, and being fixed, the working proceeds as before.—A communication from Eugene Alex. Fredk. Gognel, France.

Utilising refuse products from the Manufacture of Iron, &c., 1,919.—Mr. G. H. Birkbeck (1,919) has obtained a patent for "improvement in processes for the utilisation of certain refuse products resulting from the manufacture of iron, such processes being applicable to the treatment of other metallic or mineral substances." The refuse materials to be treated consist of slags and scoria, which contain a considerable quantity of iron, and of waste metal generally. These slags are first thrown into cold water while in a red-hot state, to render them brittle, they are then reduced to a fine state by grinding and sifting, and are mixed with bituminous coal (in the proportion of 70 per cent. of scoriæ to 30 per cent. of coal), and the mixture coked in the ordinary way. The iron contained in the slags is reduced to the metallic state, by the action of the volatile matter given out from the coal, the remaining product is a hard coke in which the iron of the slag is disseminated in a finely divided state, from which it is separated in the blast furnace.

Rope Wheels for Mines.—Mr. B. Johnson, of Chester (1,928), has obtained provisional protection for the "improvements in rope wheels for mines, collieries, and other similar purposes." The object of this invention is to afford the means of a ready adjustment of the length of the rope between the winding wheel and the cage, or skip to which it is attached: on the shaft of the rope wheel there is a boss fixed in two parts, each having a flange on the outside, forming between them a circular groove, into which is fitted the rope wheel, in such a manner that it will turn freely upon the boss when it is required to adjust the length of rope; for the purpose of fixing this wheel to the shaft, bolts are used which are put through a

series of holes drilled in a circle in both flanges, into a similar series in the solid part of the wheel; there being two or three more holes in the wheel than in the flanges, the bolts holding them together can be passed into different holes, thereby obtaining a very delicate adjustment of the length of rope. In another arrangement, for the purpose of moving the rope wheel to fractional distances, a ratchet wheel and catches are employed.

MANUFACTURE OF IRON.—Mr. C. Cockrane, of the Ormesley Iron Works, Middlesbro'-on-Tees (No. 1,885), has obtained provisional protection for "improvements in the manufacture of iron," for this purpose he uses aluminate of soda or potash, which is mixed with the iron when in a melted state, when it is about to be puddled, but its application may also be carried out at a different part of the process.

APPLICATION FOR PATENTS AND PROTECTION ALLOWED.

Jan. 6. 44. J. Leigh, Manchester, "Improvements in the treatment of gas produced by the distillation of coal, cannel, bituminous shale, boghead, mineral oils, petroleum or other combustible substances, and for the obtaining of certain products therefrom."

„ 6. 48. E. V. Gardiner, of Berner's-street, London, "Improvements in the treatment of petroleum and mineral oils, and in apparatus employed therein."

„ 9. 84. M. Henry, 84, Fleet-street, London, Patent Agent, "Improvements in furnaces."—A communication to him from H. G. Desmarest, of 33, Boulevard St. Martin, Paris.

„ 13. 114. H. Bessemer, Queen-street-place, New Cannon-street, London, "Improvements in the manufacture and treatment of malleable iron and steel, and in furnaces, machinery, and apparatus employed in such manufacture."

„ 14. 123. E. Morewood of Stratford, Essex, "Improvements in the manufacture of coated metallic sheets, or plates and pieces, and in apparatus to be used therein."

„ 20. 167. J. Mosheimer, of Dolgelly, Merionethshire, "Improvements in machinery for crushing and grinding quartz and other substances."

„ 20. 169. W. Mawson and J. Whitehead, of Calverley, near Leeds, Yorkshire "Improved hydraulic machinery for raising water in mines, wells, and other places."

„ 28. 247. E. F. Prentiss, of Birkenhead, Chester, and J. C. Sellars, of the same place, "Improvements in treating rock oil, petroleum, parafine oil, coal oil and parafine, and other like mineral oils and products therefrom."

„ 31. 291. B. Wilson, of Parliament-street, Westminster, London, "Improvements in supplying air, gases, steam, or fluids to iron and other furnaces, and to engines and vessels requiring such supply, and in the apparatus employed therein."

Feb. 2. 296. W. C. Barnes, of Enfield, Middlesex, "Improvements in means or apparatus for shaping, rolling, or compressing metal."

„ 3. 307. W. G. Valentin, of the Royal College of Chemistry, London, and F. Levick, of Blaina, Monmouth, "Improvements in generating combustible gases, and in the apparatus employed therefor."

PATENTS SEALED.

Jan. 6. 2027. R. Ridley, of Morlui, near Leeds, and James G. Jones, of No. 4, Cambridge-villas, Battersea, Surrey, "Improvements in machinery and apparatus for ventilating mines and other places."—Dated 14th July, 1862.

„ 13. 2034. C. E. Crawley, of 17, Gracechurch-street, London, and Fredk. Foster, of 7, Ashley-crescent, City-road, London, "Improvements in safety or miners' lamps."—Dated 15th July, 1862.

„ 13. 2101. J. Dickson, of 66, Tollington-road, Holloway, Middlesex, "Improvements in treating copper ores and solutions of copper, to obtain copper therefrom."—Dated 24th July, 1862.

Jan. 13. 2253. J. Dickson, of 66, Tollington-road, Holloway, Middlesex, "Improvements in treating zinc ores and solutions of zinc, to obtain zinc therefrom."—Dated 12th August, 1862.

„ 13. 2938. H. L. Corlett, of Inchicore, Dublin, "Improvements in the construction of twyers."—Dated 31st October, 1862.

„ 16. 2071. W. E. Gedge, of 11, Wellington-street, Strand, London, "Improved excavating or boring apparatus."—A communication to him from A. Trouillet, of Xertigny, Vosges, France.—Dated 21st July, 1862.

„ 23. 2148. E. T. Hughes, 123, Chancery-lane, London, "An improved process of refining the slag from blast, puddling, and other furnaces, and the employment of the refined material for mortar, stones, slabs, ornaments, and other similar articles."—A communication to him from E. Langen, of Siegburg, Prussia.—Dated 29th July, 1862.

„ 13. 2170. E. F. Prentiss, of Birkenhead, Chester, and R. A. Robertson, of Liverpool, "Improvements in obtaining products from rock oil, coal, coal tar, and other like mineral substances, in a more or less pure deodorized state, and in the apparatus to be used therefore, and which is also applicable to distillation in general."—Dated 31st, July, 1862.

„ 28. 2425. J. Mosheimer, of Manchester, "Certain improvements in machinery for amalgamating gold and silver, or the ores thereof."—Dated 2nd September, 1862.

Feb. 3. 2206. W. G. Valentin, Royal College of Chemistry, London, and F. Levich, of Blaina, Monmouth, "Improvements in the generation of combustible gases for lighting and heating purposes, and in the mode of applying such gases to the manufacture of iron, glass, and other processes where great heat is required."—Dated 6th August, 1862.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

Dec. 30, 1862. 26. P. J. Worsley, of Rotherithe, Surrey, "Improvements in the separation of silver and lead."—Dated 4th January, 1860.

Jan. 17, 1863. 130. W. W. Hewitson and B. Walker, of Leeds, "Improvements in steam hammers."—Dated 18th January, 1860.

„ 20, „ 185. F. Yates, of Berlin, "Improved apparatus for generating certain gases to be used as fuel and as reducing agents in metallurgic and other operations, and improvements in furnaces to be heated and worked therewith."—Dated 25th January, 1860.

„ 20, „ 277. W. H. Tooth, of Spring-terrace, Wandsworth-road, Surrey, "Improved machinery or apparatus to be employed in the manufacture, melting, or refining of iron and steel, and in the manufacture of puddled steel and wrought iron."—Dated 2nd February, 1860.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

Jan. 22, 1863. 44. H. Bessemer, of Queen-street-place, Cannon-street, London, "Improvements in the manufacture of iron and steel."—Dated 4th January, 1856.

„ 22, „ 356. H. Bessemer, of Queen-street-place, Cannon-street, London, "Improvements in the manufacture of malleable or bar iron and steel."—Dated 12th February, 1856.

PATENTS WHICH HAVE BECOME VOID BY THE NON-PAYMENT OF THE DUTY OF £50.

Dec. 29, 1859. 2972. T. Fearnley, of Bradford, "Improvements in steam hammers."

Jan. 10, 1860. 61. W. H. Thornthwaite, of Newgate-street, London, "Improvements in the treatment and reduction of ores, and in the manufacture of iron and steel, and in the construction and mode of working the furnaces employed in such manufactures."

„ 16, „ 112. J. Stenson, of Northampton, "Improvements in the manufacture of iron."

Jan. 21, 1860. 156. W. Gedge, of 4, Wellington-street South, Strand, London, "Improvements in retorts for the distillation of bituminous schists."—A communication from J. A. Gossot, of Epinac, France.

„ 24, „ 171. E. L. Gatellier, of La Ferté sous-Jouarre (Seine et Marne), France, "Improvements in the manufacture of the crucibles, or pots used for the reduction of zinc ores."

„ 28, „ 227. T. B. Daft, of Tottenham, Middlesex, "Improvements in casting iron."

PATENTS WHICH HAVE BECOME VOID BY THE NON-PAYMENT OF THE DUTY OF £100.

Jan. 7, 1856. 55. R. A. Brooman, of 166, Fleet-street, London, "Improvements in machinery for boring and excavating."

Metal Markets.

LONDON, *February 27th*.—There has been a fair amount of business in the metal market during the past month, and, with the exception of copper, prices generally have had an upward tendency. Shipments to America have been on the increase, and the demand for the Continent has been brisk.

IRON.—The iron trade has been depressed all through the month, and prices have had a tendency to decline.

Scotch pig-iron opened quiet at 53*s*. 9*d*., at which price it remained until the end of the month when the market became firmer, prices closing at 54*s*. 3*d*. Shipping brands have only been in small request.

Welsh bars have been in moderate demand at slightly lower rates. Prices declined from 5*l*. 15*s*. at the works, and 6*l*. 7*s*. 6*d*. in London, to 5*l*. 12*s*. 6*d*. at the works, and 6*l*. 5*s*. in London. Staffordshire descriptions remain without alteration, with a good steady demand. In Swedish bars sellers are unable to maintain last month's prices, although the stock continues low. Indian specifications 11*l*. 7*s*. 6*d*. to 11*l*. 10*s*.

STEEL.—Swedish Keg has been steady at 16*l*., faggot 17*l*. and upwards.

COPPER.—The market for this metal open dull, both raw and manufactured being obtainable under fixed rate. The reduction in English which had long been anticipated took place on the 3rd, when all sorts were put down 9*l*. per ton. In the middle of the month a large business was done both for immediate and forward delivery, in some instances a couple of pounds above fixed prices being obtained. At the end of the month there was a good demand for raw, and full prices were readily paid, but there was a difficulty in buying except above fixed quotations; manufactured not quite so brisk. Foreign has been very dull and prices merely nominal. Burra Burra 95*l*. Kapunda 95*l*. Chili 82*l*. 10*s*. to 83*l*. 17*s*. 6*d*. Spanish 85*l*. to 87*l*.

YELLOW METAL.—This article has receded in price simultaneously with copper. A fair amount of business has been done, but under fixed rates. Sheating 8*d*. to 8¼*d*.; braziery sheets 7¾*d*. to 8*d*.

TIN.—This metal has been in great request all through the month, and on the 24th smelters advanced the rates 4*l*. per ton. A very large business has been done in Straits, and prices have advanced upwards of 2*l*. per ton, fully 10,000 slabs having changed hands at 122*l*. 10*s*. There have been

large sales in Banca at from 122*l.* 10*s.* to 124*l.* The Dutch market has advanced from 70 florins to 73 florins with transactions at intermediate prices.

LEAD.—The market for this metal has been quiet. Soft English 21*l.* 5*s.* to 21*l.* 10*s.*, W. B. has been in request at 22*l.* 15*s.* to 23*l.*

SPELTER.—A good business was done in this article in the early part of the month at firm prices, but towards the end of the month the demand fell off, although holders remained steady. On the spot 18*l.* 5*s.*; spring shipment 18*l.* 10*s.*; W. H. 18*l.* 12*s.* 6*d.* to 18*l.* 15*s.* Hull parcels according to hand 18*l.* 2*s.* 6*d.* to 18*l.* 5*s.*

CANTON, *January* 1*st.* LEAD.—There has been a good demand, and sales of common were made at one time at 8 dollars 50 cents, but prices have since declined to 8 dollars to 8 dollars 20 cents for common, and 9 dollars for W. B. mark.

IRON.—1,800 piculs nailrod, 2 dollars 40 cents.

TIN PLATES.—200 boxes, 5 dollars 80 cents. to 6 dollars.

Furnished by Von Dadelszen and North, 158, *Leadenhall Street, London, E.C., 27th February*, 1863.

We have to report a good business in metals during the present month, fluctuations have taken place both in copper and tin. In the former article the smelters have reduced the official prices of raw 9*l.* per ton, whilst on the other hand the official prices of English tin have been advanced 4*l.* per ton. Money is also cheaper now than at the beginning of the month, and unless adverse political events intervene, we think an increased business may very fairly be looked for as the spring advances.

IRON.—Welsh bars have been in rather slack demand, prices are somewhat easier, 5*l.* 10*s.* in Wales, and 6*l.* 5*s.* Staffordshire is steady, prices unaltered, Scotch pigs have altered in value from time to time, closing at 54*s.* cash, about the same price as they opened on the 1st instant.

COPPER.—The reduction of the 9*l.* per ton made in the price of this article took place on the 3rd February, and immediately brought forward numerous buyers, so much so that large parcels changed hands at prices considerably above fixed rates. However, the market closes steady with sellers at official prices. We quote tough cake 89*l.*, manufactured 96*l.* per ton; Burra, 94*l.* 10*s.* to 95*l.*; Kapunda ingots, 96*l.* 10*s.*; Spanish, 85*l.* to 87*l.*; Chili, 83*l.* 10*s.*

TIN.—On the 24th, the smelters advanced the price of English tin 4*l.* per ton all round. A very large business has been done in Foreign, and prices have advanced considerably, Straits now sell from 121*l.* to 122*l.* 10*s.* according to prompt, and Banca from 122*l.* 10*s.* to 124*l.* The Dutch market has advanced to 73*f.*, and closes firm with an upward tendency.

Tin plates makers are fairly supplied with orders, but prices are unaltered.

LEAD is quiet, but prices are firmly maintained.

SPELTER.—This market has ruled quiet, but steady in price during this month. The complication in Poland may possibly lessen the production of this article, and, if so, prices would probably advance. To-day we quote spot 18*l.* 5*s.*, and April and May shipment 18*l.* 10*s.*; W. H. 18*l.* 10*s.*; Hull parcels, 18*l.*

Metallic-Ore Markets.

London, February 27th, 1863.

TIN.—The tin standard has advanced 3*l.* since our last; it therefore stands at—

Superior Fine	.. £110	Superior Common	.. £106
Second Fine	.. 108	Second Common	.. 105

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard have been as follows:—

Date.	*Tons.*	*Produce.*	*Fine Copper.* Tons. cwt.	*Price per ton.*	*Standard.*
Jan. 29.	.. 3,797	.. 6¾ ..	241 12	£4 19 6	£121 5 0
Feb. 5.	.. 3,869	.. 6¾ ..	255 18	5 0 0	117 0 0
„ 12.	.. 2,940	.. 7¼ ..	208 7	5 6 0	113 13 0
„ 19.	.. 5,101	.. 5¾ ..	287 5	4 0 6	120 2 0

At the sale of the 29th the standard declined 2*l.* On February the 5th there was another fall of 3*l.* 5*s.* At the sale of the 12th the standard again went down 1*l.*; and on the 19th the decline was 2*l.* Making a total decline for the four sales of upwards of 8*l.*

LEAD.—Comparing the sales of this month with those of last we find that prices have considerably advanced.

Coal Markets.

London, February 27th.

LONDON.—From the returns of the Registrar of the London Coal Exchange, of the quantity of sea-borne Coal, Culm, and Cinders, imported into London in the month of January, we learn that the total quantity was 273,419 tons, against 233,020 tons during the corresponding month of last year, showing an *increase* of 40,399 tons.

The following are the particulars of the 273,419 tons imported during January:—

Newcastle ..	88,903 tons, in	ships	Scotland ..	2,297 tons, in	ships
Seaham ..	18,854 „	„	Wales ..	5,907 „	„
Sunderland .	87,729 „	„	Yorkshire ..	5,403 „	„
Middlesbro'.	5,347 „	„	Small Cinders	2,938 „	„
Hartlepool..	53,873 „	„			
Blyth ..	2,170 „	„			

The quantity of coal imported by railways and canals during the month of January was 159,917 tons, against 127,003 tons during the corresponding month last year—showing an *increase* of 32,914 tons.

On the 26th of January large arrivals caused an abundant supply of all sorts, and the market was dull. The prices for the different kinds were:—best house coal 17*s.* 6*d.* to 18*s.* 6*d.*; seconds 16*s.* to 17*s.*; Hartley's 14*s.* 6*d.* to 15*s.* 6*d.*; manufacturers 13*s.* to 15*s.* On the 28th further arrivals caused increased heaviness, and prices were reduced 6*d.* per ton, Hartley's 3*d.* On the 30th more arrivals together with the mild weather caused increased dulness, and another reduction of 6*d.* per ton. On February 2nd there were few arrivals, the quantity on sale, however, was in excess of the demand

and business in house and steam coal was very dull, at a reduction of from 3*d.* to 6*d.* per ton. On the 4th there were few arrivals, and an increased demand for all descriptions of coal at fully last prices. On the 6th the arrivals were considerable. The market was very quiet. On the 9th very large arrivals caused an abundant supply of all descriptions; on the whole the market was active. On the 11th the market was heavy, all sorts being reduced 3*d.* per ton. On the 13th there were few arrivals and more inquiry for coals generally at last prices. On the 16th there was a good demand for all sorts at an increase of from 3*d.* to 6*d.* per ton. On the 18th there were few arrivals, and the tone of the market was quiet. On the 20th best house coal was in demand at an advance of 3*d.* per ton. On the 23rd the arrival of 82 fresh ships, together with those remaining from last week gave a supply beyond the immediate requirements of the trade and business was dull for everything, but first class house coal at Friday's prices. Best house coal 16*s.* 17*s.* 6*d.*; seconds 13*s.* to 14*s.* 6*d.*; Hartley's 12*s.* 6*d.* to 14*s.*; manufacturers 11*s.* to 14*s.* per ton. On the 25th the depression noticed on the 23rd increased, by the unexpected arrival of 95 ships. No quotable alteration took place in prices, but the business transacted was trifling in amount. On the 27th 36 arrivals created much depression in the markets, all coals being quoted at last day's prices, best house coal 16*s.* to 17*s.* 6*d.*; seconds 13*s.* to 14*s.* 6*d.*; Hartley's 12*s.* 6*d.* to 14*s.*; manufacturers 11*s.* to 14*s.* per ton. 64 cargoes unsold. 60 ships at sea.

General Exports of Coal.—From Messrs. J. and T. Platt's Coal Circular for December, we find that the quantity of *coal, cannel, coke, and patent fuel shipped from Liverpool* to foreign and colonial ports during the month of January was 40,005 against 39,780 tons, during the corresponding month of last year—showing an *increase* of 1,225 tons. The shipments coastwise during January were 5,415 tons, against 5,175 tons during the correponding month last year—showing an *increase* of 240 tons.

Contracts for Coal.—The Admiralty require the supply of 500 tons of South Wales coal, for Nassau, New Providence: also 3,000 tons of the same coal for the Naval Yard at Jamaica.

London Share Market.

London, February 26th, 1863.

The business of the past month has been generally quiet, and of a less gambling nature than for some time previously. But although quiet, things on the whole have been firm; and indeed there have been less violent fluctuations than during any similar period for some time past. The fall in the standard has no doubt affected shares in copper mines, but not to any great extent; and has probably been fully balanced by the increased firmness in the tin markets.

A large amount of business has been transacted in *East Caradon.* Shares opened at 48*l.*-49*l.* but not much doing. They fluctuated between these prices until the 6th when they receded to 46½*l.*-47*l.*, and were very dull with sellers prevailing. On the 14th they rose to 47*l.*-48*l.* at which they were in demand. Since that date they gradually declined to 44¾*l.*-45*l.*, but again rallied, and close at 45¾*l.*-46*l.* *West Caradon* shares have advanced and again receded in price. They opened at 33*l.*-35*l.* and on the 2nd advanced to 37*l.* buyers. Since then, however, they have steadily declined and close at 30*l.*-32*l.* *South Caradon,* 400*l.*-410*l.* *Gonamena,* 2¾*l.*-3*l.* *South Caradon Wheal Hooper,* 18*s.* 6*d.*-20*s.* *Wheal Pollard,* 16*s.*-18*s.*

A very large business has been done in *Wheal Seton*, although on the whole prices have not altered to any considerable extent. Shares opened at 237½*l.*-242½*l.* On the 4th they reached their highest price of 245*l.*-255*l.*, at which they were in active demand. They then began to recede, and on the 15th had gone as low as 217½*l.*-222½*l.* They rapidly improved again, however, and, after reaching 240*l.*-245*l.* on the 17th, close at 232½*l.*-237½*l.* *West Seton* shares have receded a little in price. They opened at 285*l.*-295*l.*, and after going down to 260*l.*-270*l.* on the 16th, they close at 270*l.*-280*l.* *New Seton* 130*l.*-140*l.*

North Roskear shares opened flat at 46*l.*-48*l.*, but a demand sprang up for them, and on the 3rd they advanced to 51*l.*-53*l.* After that date they declined until the 18th when they were flat at 46½*l.*-47*l.* They partially recovered again shares being short, and close at 49*l.*-51*l.* *North Crofty* shares have been in fair demand at steady prices. They opened 4⅜*l.*-4½*l.*, and close 4½*l.*-5*l.*

Wheal Harriett shares have declined considerably during the month. They opened firm at 5¾*l.*-6*l.* and fluctuated for some time between 5*l.* and 5½*l.* On the 10th they reached the lowest price of 3½*l.*-3¾*l.* They have recovered a little and close firm at 3⅝*l.*-3¾*l.* *Stray Park* shares have ranged from 39*l.*-40*l.* to 37*l.*-38*l.* at which they close. *Carn Camborne* 15*s.*-17*s.*

The principal feature in the market towards the end of the month was the sudden rise in *East Basset*. These shares opened at 51*l.*-53*l.*, from which they declined to 45*l.*-47*l.* On the 21st they suddenly advanced to 55*l.* with many buyers but no sellers. They close at 75*l.*-77*l.* *Wheal Basset* shares have declined 10*l.* per share on our last quotations, closing at 67½*l.*-72½*l.* *North Basset* 3½*l.*-3¾*l.* *Wheal Buller* 60*l.*-65*l.* *West Basset* 12*l.*-13*l.*

Wheal Ludcott shares have experienced a heavy fall. They opened at 9½*l.*-9¾*l.*, and on the 3rd were freely dealt in at 8*l.*-8½*l.* Since that date they steadily declined to 5*l.*-5½*l.*, but again rallied and close 6½*l.*-7*l.* *Cargoll* shares have been firm at slightly advanced prices. They opened at 43*l.*-44*l.* and close at 45*l.*-46*l.* *Herodsfoot* shares have receded from 49*l.*-51*l.* to 47*l.*-48*l.* *Wheal Trelawny* 17*l.*-18*l.* *Wheal Mary Ann* 16*l.*-17*l.*

West Tolgus shares have been in good request at advanced prices. They opened at 61*l.*-63*l.* and close at 66*l.*-68*l.* There has been a large demand for *South Tolgus* and shares have advanced upwards of 10*l.* They opened at 58*l.*-60*l.*, buyers, and close at very firm and in request at 68*l.*-70*l.* *Great South Tolgus* 6½*l.*-7*l.* *Wheal Uny* 6½*l.*-6¾*l.* *Wheal Union.* 5*l.*-5½*l.*

A good deal of business has been transacted in *East Russell.* Shares opened at 5½*l.*-6*l.* and on the 10th they were quoted at 6*l.*-6½*l*; but on the 12th they suddenly dropped to 4½*l*-4⅝*l.*, and close at 5*l.*-5¼. *Wheal Crebor* shares have been dealt in at 17*s.* 6*d.*-19*s.* 6*d.* *Drakewalls* shares are slightly weaker, being quoted at closing at 2⅛*l.*-2½*l.* *Kelly Bray* 12*s.* 6*d.*-15*s.* *Lady Bertha* 20*s.*-22*s.* *Devon Great Consols* 515*l.*-525*l.*

Great Wheal Fortune shares have been largely dealt in and at one time went up 4*l.* per share. They opened at 31*l.*-33*l.*, buyers, and on the 18th were in good demand at 35½*l.*-36*l.* After that date they declined to 31*l.*-33*l.*, but close 33½*l.*-34*l.* *Wheal Grylls*, 31*l.*-33*l.* *Calvadnack*, 6½*l.*-7*l.*

Tincroft shares have been in steady request at advancing prices. They opened at 15½*l.*-16*l.*, and shares have continually though slowly advanced to 18*l.*-18½*l.*, at which they close. A good deal of business has been done in *Cook's Kitchen.* Shares opened at 30½*l.*-31½*l.* On the 6th they went as high as 34*l.*-35*l.*, but soon dropped again to 30*l.*-31*l.*: they close 31*l.*-31½*l.* *Condurrow* 90*l.*-95*l.* *Dolcoath*, 570*l.*-600*l.*

Marke Valley shares remained without alteration for some time, but close 8½*l.*-8¾*l.* *South Phœnix* 2½*l.*-2¾*l.* *North Phœnix* 7*l.*-7½*l.* *West Rose Down* 12½*l.*-15*l.*

East Carn Brea shares have declined 2*l.* per share. They opened at

11½*l.*-12*l.* and have since gradually declined, closing at 9¾*l.*-10*l.* *South Frances*, 85*l.*-90*l.*

Clifford Amalgamated shares have slightly declined since our last quotation. They opened at 23*l.*-25*l.* and close flat at 20*l.*-21*l.* *West Damsel*, 60*l.*-65*l.* *Clijah and Wentworth*, 5*l.*-6*l.*

East Rosewarne shares have remained with little fluctuation at about 3¼*l.*-3⅛*l.* *Wheal Kitty* (St. Agnes). 4⅛*l.*-4⅜*l.* *North Downs* shares have receded in price. They opened at 3⅛*l.*-3⅜*l.* and close at 2¾*l.*-3*l.* *North Treskerby* have ranged from 4⅛*l.*-4⅜*l.* to 3¾*l.*-4*l.* *Pendeen Consols*, 6*l.*-6¼*l.*

Wheal Grenville shares have not altered in price being quoted at 5*l.*-5¼*l.* *East Grenville*, 47*s.* 6*d.*-50*s.* *West Frances*, 16*l.*-18*l.*

Providence shares have advanced a little during the month, from the opening price 42*l.*-43*l.* to 43*l.*-45*l.*, but close 42*l.*-43*l.* *Wheal Margaret* shares have declined 4*l.* per share. They opened at 40*l.*-42*l.* and close at 36*l.*-38*l.* *Rosewall Hill and Ransom United*, 3¼*l.*-3⅛*l.*

Transactions are also reported in the following mines:—*Holmbush*, 35*s.*-40*s.* *East Wheal Agar*, 11½*l.*-12*l.* *Grambler and St. Aubyn*, 16*l.*-18*l.* *Great Retallack*, 11*s.*-13*s.* *Alfred Consols*, 17*s.* 6*d.*-20*s.* 6*d.* *North Dolcoath*, 2*l.*-2½*l.* *Hingston Downs*, 2¼*l.*-2½*l.* *Goonzion*, 18*s.*-20*s.* *South Herodsfoot*, 5¼*l.*-5⅜*l.* *New Wendron*, 4*l.*-4½*l.* *Tolcarne*, 3¼*l.*-3½*l.* *Wheal Unity*, 10*s.*-11*s.* *Trumpet United*, 9*s.*-11*s.*

In colonial and foreign mines prices have been quoted as follows:—*Dun Mountain*, ½-⅜. *St. John Del Rey*, 54¼*l.*-56*l.* *United Mexican*, 5⅞*l.*-6*l.* *Fortuna*, 4¾*l.*-4⅞*l.* *Cobre*, 21*l.*-22*l.* *Copiapo*, 7½*l.*-8¾*l.* *Montes Aureos*, 3¼*l.*-3¾*l.* *Santa Barbara*, ½-⅝. *Lusitanian*, 1¾*l.* *Mariquita*, ¾-⅞. *Kapunda*, 1⅜*l.*-1½*l.* *Port Phillip*, 1½*l.*-1⅝*l.*

New undertakings have been quoted at the following prices:—*East Clogau*, ⅛ dis.-par. *West Clogau*, ¼ dis.-par. *St. David's*, ¼ dis.-par. *Nova Scotia*, ⅜-½ dis. *Dolfrwynog*, ⅛ dis. ⅛-prem. *East Cambrian*, par. ¼-prem. *St. Cuthbert's*, ¾-1½ prem. *Anglo Prussian*, ¾-1¼ prem. *Cape Copper*, 1¼-1⅛ prem.

Provincial Share Markets.

DUBLIN.—The following is condensed from the *Mining Journal*:—The market has been active all through the month and a considerable business has been done. *Wicklow Copper* shares were in great request through the early part of the month, and advanced nearly 5*l.* on our last quotation, and were freely taken at 45*l.* Towards the latter part of the month, however, they rapidly declined to 41*l.* 15*s.*, and sellers predominating they close flat at 41*l.* 10*s.* *Mining Company of Ireland* shares have been largely dealt in at slightly advanced prices. They opened at 19*l.* 5*s.* to 19*l.* 10*s.* and close in demand at 19*l.* 15*s.* to 19*l.* 17*s.* 6*s.* *General Mining Company for Ireland* shares have been in request at 5*l.* 5*s.* to 5*l.* 7*s.* 6*d.* *Carysfort* shares opened at 18*s.* 6*d.*, but towards the end of the month they advanced to 22*s.* and close in request at 21*s.* *Connorree* shares have been firm at 21*s.*

CORNWALL.—The following is condensed from the *West Briton*:—The mining market has been fairly active through the month, and a good average amount of business has been done. *Copper Hill* shares have advanced 10*l.* per share on our last quotations. They opened at 70*l.*—75*l.* and close firm at 80*l.*—85*l.* *South Crofty* shares have declined considerably during the month. They opened at 32*l.*—32½*l.* and close flat at 25*l.*—26*l.* *Wendron Consols* shares have been firm at 11*l.*—11½*l.* *Emily Henrietta* 9½*l.*—10*l.* *Wheal Agar* shares were done at 6*l.* in the early part of the month, but have since declined, closing at 4½*l.*—4¾*l.* *Wheal Reath* 42*l.*

Tabular Abstract of Mining Accounts for the Month.

Date of Meeting.	Name of Mine, and Number of Shares.	Balances. Debit. £ s. d.	Balances. Credit. £ s. d.	Calls. Per Share. £ s. d.	Calls. Total. £ s. d.	Dividends. Per Share. £ s. d.	Dividends. Total. £ s. d.
	CORNISH AND DEVON MINES.						
Jan. 21	East Margaret (1,024)	658 5 2	—	0 10 0	512 1 0	—	—
„ 21	Bottle Hill (5,000)	100 0 0	—	0 2 0	500 0 0	—	—
„ 22	North Jane (2,000)	653 8 7	—	0 5 0	500 0 0	—	—
„ 22	Furze Hill Wood (6,000)	447 12 9	—	0 1 6	450 0 0	—	—
„ 22	Wendron Consols (1,024)	1,153 11 1	—	1 0 0	1,024 0 0	—	—
„ 23	Rosewarne United (4,096)	1,059 16 7	—	—	—	—	—
„ 26	Copper Hill (256)	—	274 2 10	—	—	—	—
„ 26	Wheal Harriett (5,120)	—	40 7 0	—	—	—	—
„ 27	South Caradon (512)	—	4,743 12 9	—	—	5 0 0	2,560 0 0
„ 27	East Wheal Basset (512)	—	1,066 7 9	—	—	1 0 0	512 0 0
„ 27	East Beam (3,000)	—	282 10 9	0 2 0	300 0 0	—	—
„ 28	West Basset (6,000)	—	1,555 11 0	—	—	0 5 0	1,500 0 0
„ 28	Wheal Sidney (4,096)	700 0 0	—	—	—	—	—
„ 28	Rosewall Hill and Ransom (6,000)	—	294 0 0	—	—	—	—
„ 28	Polhigey Moor (6,000)	778 11 9	—	0 3 6	1,050 0 0	—	—
„ 28	Wheal Trannack (512)	16 10 1	—	0 7 6	192 0 0	—	—
„ 29	Craddock Moor (1,055)	—	64 13 6	—	—	—	—
„ 29	East Jane (6,145)	40 7 6	—	0 3 6	1,075 7 6	—	—
„ 29	Lady Bertha (6,000)	—	409 9 4	0 3 6	1,050 0 0	—	—
„ 29	West Tolgus (512)	—	4 6 1	1 0 0	512 0 0	—	—
„ 30	North Wrey (4,000)	—	90 8 2	0 2 6	500 0 0	—	—
„ 30	Great Wheal Fortune (1,798)	—	1,794 14 8	—	—	0 15 0	1,348 0 0
Feb. 2	Pend-an-drea United (8,465)	—	1,125 0 0	0 1 0	423 5 0	—	—
„ 3	South Caradon Wheal Hooper (4,096)	275 10 10	—	0 2 0	409 12 0	—	—
„ 3	Goonzion (2,000)	341 0 0	—	0 3 6	350 0 0	—	—
„ 3	Wheal Basset (512)	—	1,324 0 0	—	—	1 0 0	512 0 0
„ 3	Herodsfoot (1,024)	—	—	—	—	1 15 0	1,792 0 0
„ 4	Wheal Margery (1,024)	694 0 0	—	—	—	—	—
	Calvadnack (915)	343 0 0	—	0 7 6	343 2 6	—	—
	South Basset (512)	486 0 0	—	1 0 0	512 0 0	—	—
„ 5	West Polmear (6,000)	468 7 3	—	0 2 6	750 0 0	—	—
„ 5	West Frances (512)	1,383 4 11	—	2 10 0	1,280 0 0	—	—
„ 9	Wheal Seton (396)	—	2,497 7 2	—	—	3 0 0	1,188 0 0
„ 9	Dolcoath (358)	—	3,606 2 7	—	—	8 0 0	2,864 0 0
„ 10	North Treskerby (5,936)	—	1,001 13 0	—	—	0 1 6	445 4 0
„ 10	Drakewalls (12,800)	—	1,670 0 0	—	—	0 1 6	960 0 0
„ 10	West Trevelyan (5,481)	923 17 8	—	0 4 0	109 12 0	—	—
„ 12	St. Day United (4,000)	1,917 0 0	—	0 10 0	2,000 0 0	—	—
„ 12	Wheal Norris (6,000)	1,460 6 11	—	0 5 0	1,500 0 0	—	—
„ 13	Creegbraws and Penkeville (512)	—	52 16 6	—	—	—	—
„ 16	West Seton (400)	—	3,147 8 11	—	—	5 0 0	2,000 0 0
„ 17	Wheal Jane (512)	368 0 1	—	—	—	—	—
„ 17	Cuddra (6,000)	1,002 4 0	—	0 5 0	1,500 0 0	—	—
„ 17	Wheal Unity Consols (6,000)	1,302 18 6	—	0 4 0	1,200 0 0	—	—
„ 17	South Carn Brea (6,000)	2,673 3 9	—	0 8 0	2,400 0 0	—	—
„ 18	Clifford Amalgamated (2,900)	380 12 8	—	—	—	—	—
„ 18	West Caradon (1,024)	422 1 1	—	—	—	—	—
„ 18	Tolvadden (6,000)	324 15 3	—	0 5 0	1,500 0 0	—	—
„ 18	Camborne Consols (1,000)	156 1 3	—	0 4 0	200 0 0	—	—
„ 19	Trungle (6,000)	1,151 17 2	—	0 5 0	1,500 0 0	—	—
	WELSH MINES.						
Jan. 26	Bronfloyd (5,000)	—	1,402 0 11	—	—	0 3 0	750 0 0
„ 28	Bryntail (1,960)	204 0 0	—	—	—	—	—
Feb. 4	Merllyn (4,480)	94 17 4	—	0 1 0	224 0 0	—	—
„ 4	Garreg (1,000)	237 6 5	—	0 3 0	150 0 0	—	—
	Michell (3,475)	4 6 3	—	0 1 0	173 15 0	—	—
	Parys (200)	—	6,739 2 3	—	—	10 0 0	2,000 0 0
	FOREIGN MINES.						
Jan. 26	Port Philip and Colonial (100,000)	—	—	—	—	0 3 6	1,750 0 0
„ 30	Hindostan Copper Company (24,000)	—	2,098 4 7	—	—	—	—
Feb. 20	Clarendon Consols (60,000)	—	5,200 0 0	—	—	—	—

Prices Current of Metals.

From Messrs. JAMES and SHAKSPEARE'S, 10, Austin Friars, E.C. *25th Feb.*

						Per Ton.				
IRON	Bars	(Welch) ..	in Wales ..	£5	10	0	@	£5	15	0
	„	„ ..	„ Liverpool	6	2	6	„	6	7	6
	„	„ ..	„ London	6	10	0	„	6	12	6
	Nail Rods	„ ..	„ Wales ..		—		„	6	5	0
	„	(Staffordshire) „	Liverpool	6	12	6	„	7	0	0
	„	„	„ London	7	0	0	„	7	10	0
	Hoops	„	„ Liverpool	8	0	0	„	8	2	6
	„	„	„ London	8	7	6	„	8	10	0
	Sheets	„	„ Liverpool	8	12	6	„	9	5	0
	„	„	„ London	9	5	0	„	9	10	0
	Bars	„	„ Liverpool	6	15	0	„	7	0	0
	„	„	„ London	7	7	6	„	7	10	0
	Scotch Pig (No. 1. g.m.b.)		the Clyde	2	13	9	„	2	14	3
	Rails		in Wales	5	10	0	„	5	15	0
	Swedish—Hammered—large sizes				—		„	11	5	0
	„	„ Indian assortments			—		„	11	10	0
STEEL	Hammered—faggot				—		„	17	0	0
	„	in kegs ½ and ⅝ in...			—		„	16	0	0
COPPER	Burra and P.C.C.				—		„	95	0	0
Australian ..	Kapunda				—		„	97	0	0
	Wallaroo			95	0	0	„	96	0	0
American....	Baltimore				—		„	99	0	0
	Lake Superior				—		„	98	0	0
	Spanish Cake			85	0	0	„	87	0	0
	Chili and other Slab, for 96 per cent. pure Copper				—		„	83	0	0
English	Tough Cake and Ingot and Tile				—		„	89	0	0
	Best selected Ingot				—		„	92	0	0
	Sheets, Sheathing and Rod				—		„	96	0	0
	Flat Bottoms				—		„	101	0	0
						Per lb.				
YELLOW METAL	Sheets				—	8*d.*		8¼*d.*		
	Sheathing and Rod				—	8¼*d.*		8¼*d.*		
						Per Cwt.				
TIN	Common Blocks and Ingots				—		„	119*s.*		
English ..	„ Bars (in barrels)				—		„	120*s.*		
	Refined				—		„	124*s.*		
Foreign ..	Straits, Fine			121*s.*			„	122*s.* 6*d.*		
	Banca			124*s.*			„	125*s.*		
						Per Box.				
TIN PLATES	Charcoal IC, best			28*s.* 6*d.*			„	29*s.*		
at Liverpool	„ IX „			34*s.* 6*d.*			„	35*s.*		
6*d.* Less	Coke IC			22*s.* 6*d.*			„	24*s.* 6*d.*		
	„ IX			28*s.* 6*d.*			„	30*s.* 6*d.*		
						Per Ton.				
LEAD	Sheet				—		„	£21	10	0
English ..	Pig—W.B.				—		„	22	15	0
	„ Other good brands			21	5	0	„	21	10	0
	„ German and Spanish, soft ..			20	12	6	„	20	17	6
English ..	Red				—		„	21	15	0
	Shot				—		„	23	10	0
	Dry White				—		„	26	10	0
SPELTER	(Silesian) in Cakes			18	5	0	„	18	7	6
ZINC	(Sheet) No. 9 and upwards			23	5	0	„	23	10	0
						Per Bottle.				
QUICKSILVER	(in bottles containing 75lbs. each)				—		„	7	0	0
						Per Ton.				
REGULUS OF ANTIMONY, French Star					—		„	41	0	0

Copper Ores.

Sampled Jan. 14, and sold at Tabb's Hotel, Redruth, Jan. 29.

Mines.	Tons.	Purchasers.	Price.
South Caradon	116	6	£8 1 6
	96	9	8 9 6
	93	2	5 3 6
	65	2	5 5 6
	64	1	14 7 6
	40	1	5 0 6
	33	1	15 16 6
West Caradon	68	8	8 3 6
	67	9, 11	5 2 6
	65	2	5 5 0
	62	6	4 16 6
	56	11	7 11 6
	44	1	8 13 6
	43	8	5 16 6
	42	1	4 1 6
	20	5	1 10 6
Great Wheal Busy	91	1, 12	1 14 6
	77	10	2 2 0
	68	10	2 6 6
	55	7	5 12 6
	45	5	3 7 6
	41	5	3 5 6
	38	10	2 4 0
	35	5, 10, 12	2 10 0
	1	5	22 16 0
North Treskerby	71	6	5 13 6
	63	13	5 6 6
	60	5	4 10 0
	54	7	3 7 0
	53	4, 6	4 11 6
	50	13	4 1 6
	44	7	3 18 0
Clifford Amalgamated	78	12	3 3 6
	74	9	3 16 6
	53	7	4 19 0
	42	10	0 14 0
	40	12	0 19 6
	34	12	3 7 6

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	33	12	£2 6
	30	12	0 5 6
Fowey Consols	84	5	4 18 6
	76	1	5 16 6
	70	5	5 13 6
	50	5	4 19 6
Wheal Polmear	74	4, 6	5 0 6
	72	5	10 6 0
	65	5	4 19 6
	39	5	15 13 0
Tywarnhaile	68	7, 10, 13	2 5 0
	53	3, 10	1 11 0
	44	12	1 9 0
	35	3, 7	6 13 6
North Downs	56	7	5 4 6
	55	7	5 16 6
	54	3, 7	7 5 6
	35	9, 11	6 17 0
Craddock Moor	59	1	5 4 6
	47	1	5 13 0
	44	1, 9	4 2 6
South Crinnis	70	13	2 13 0
	62	13	3 11 0
St. Day United	35	10	1 14 0
	30	8	3 4 0
	29	7	1 13 0
Prideaux Wood	60	5	3 3 0
Molland Mine	55	13	5 0 6
Burra Burra	33	5	3 11 0
	11	1	3 14 0
Wheal Prudence	40	12	1 19 6
Wheal Towan	25	5	1 17 6
	12	2	4 0 6
Perran Mines	24	1	4 0 6
	4	1	7 0 6
East Wheal Ellen	10	1	3 10 0
Goonzion	8	2	5 11 6
Eddy's Ore	6	2	3 6 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
South Caradon	506	£4,209 12 0
West Caradon	467	2,797 14 0
Great Wheal Busy	451	1,266 4 0
North Treskerby	395	1,807 2 6
Clifford Amalgamated	384	1,061 3 6
Fowey Consols	280	1,502 8 0
Wheal Polmear	250	2,047 3 6
Tywarnhaile	200	532 11 6
North Downs	200	1,245 11 6
Craddock Moor	150	755 6 6
South Crinnis'	132	405 12 0

	Tons.	Amount.
St. Day United	94	£203 7 0
Prideaux Wood	60	189 0 0
Molland Mine	55	276 7 6
Burra Burra	44	157 17 0
Wheal Prudence	40	79 0 0
Wheal Towan	37	95 3 6
Perran Mines	28	124 14 0
East Wheal Ellen	10	35 0 0
Goonzion	8	44 12 0
Eddy's Ore	6	19 16 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	521½	£3,582 4 9
2 Freeman and Co.	249	1,278 2 0
3 Grenfell and Sons	101	950 6 3
4 Crown Copper Co.	63½	307 3 3
5 Sims, Willyams & Co.	676¾	3,726 13 4
6 Williams, Foster, & Co.	311½	1,937 17 3
7 Mason and Elkington	413⅛	1,949 5 9
8 Bankart and Sons	111	806 7 6
9 Copper Miners' Co.	243	£1,478 19 3
10 Charles Lambert	320 5-6	613 10 10
11 Newton, Keates & Co.	107	715 15 3
12 Sweetland, Tuttle & Co.	356½	736 16 7
13 Neath Copper Co.	322¾	1,272 4 0
Total	3797	£18,855 6 0

Average Produce, 6¾.
Quantity of Fine Copper, 241 tons 12 cwt.

Average standard £121 5 0
Average Price per ton 4 19 6

Copper Ores.

Sampled Jan. 21, and sold at Tabb's Hotel, Redruth, Feb. 5.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	101	3	£5 16 6
	99	3	4 16 0
	90	3	5 18 6
	89	3	5 18 6
	88	3	5 1 0
	76	3	6 3 0
	74	3	3 9 6
	61	3, 7	3 11 6
	60	3	5 11 6
	59	3	5 7 6
	51	5	3 10 0
	35	1	4 7 6
(Consols)	56	3	4 14 0
West Seton	98	5	2 10 0
	80	1, 13	6 15 6
	67	1, 13	4 15 6
	64	2, 6	4 16 6
	63	2, 6	4 12 0
	56	13	6 0 0
	53	6	6 3 6
	44	13	7 1 0
	38	8	4 7 0
Wheal Seton	14	9	3 5 6
(Pendarves)	89	7	3 19 0
	74	9	4 19 6
	63	1, 5	11 19 0
	53	10	1 1 6
	52	9	6 8 0
East Pool	85	7	3 16 6
	60	5	0 10 6
	52	1, 4, 6	3 7 6
	50	2	4 5 6
	41	5	4 2 0
	37	10	2 16 6
Wheal Basset	60	1	5 3 6
	51	7	5 4 0
	40	5	6 0 6
	36	1	5 10 0
	34	7	6 4 0
	1	5	22 2 0

Mines.	Tons.	Purchasers.	Price.
South Frances	46	5	£4 0 6
	45	1	8 10 0
	44	9	6 17 0
	43	1	5 7 0
	26	1, 9	5 18 6
	6	1	3 15 0
Tincroft	53	10	2 0 0
	50	2, 4, 6, 9	4 11 6
	42	9	2 17 6
	33	9	5 3 0
	20	9	3 6 6
Wheal Grenville	50	1	4 7 6
	38	7	8 16 6
	27	9	5 7 6
	24	12	9 7 0
	23	9	3 8 0
	20	1, 9	8 5 0
South Tolgus	84	2, 6, 7	3 10 0
	80	4, 6	4 17 0
Condurrow	61	8	1 18 6
	57	11	4 18 0
	12	7	3 12 6
Dolcoath	52	7	3 15 6
	42	1, 9	4 10 6
	31	7	2 11 6
East Basset	53	5	4 7 6
	34	5	7 14 0
	29	5	9 7 0
South Crofty	49	10	1 7 6
	27	4, 6	6 6 6
North Roskear	54	1, 2	8 8 6
	20	1, 2	9 0 6
Camborne Vean	30	11	6 3 0
	26	4, 6	4 0 6
Stray Park	54	1, 7	3 11 6
Bampfylde	40	5	11 7 0
East Grenville	21	8	2 18 6
Wheal Nelson	6	5	4 5 0
Garlidna	3	5	16 3 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amalgamated	939	£4,757 11 6
West Seton	563	2,844 6 0
Wheal Seton & Pendarves	345	1,908 3 6
East Pool	325	1,018 10 0
Wheal Basset	222	1,247 12 0
South Frances	220	1,336 0 6
Tincroft	208	725 4 0
Wheal Grenville	182	1,156 8 0
South Tolgus	164	682 0 0
Condurrow	130	434 2 6

	Tons.	Amount.
Dolcoath	125	£496 3 6
East Basset	116	764 16 6
South Crofty	76	238 3 0
North Roskear	74	685 9 0
Camborne Vean	56	289 3 0
Stray Park	54	193 1 0
Bampfylde	40	454 0 0
East Grenville	21	61 8 6
Wheal Nelson	6	25 10 0
Garlidna	3	48 9 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	510½	£3,080 17 3
2 Freeman and Co.	191	985 19 3
3 Grenfell and Sons	822½	4,316 18 3
4 Crown Copper Co.	96½	447 8 0
5 Sims, Willyams & Co.	533½	2,740 11 0
6 Williams, Foster & Co.	240½	1,171 19 6
7 Mason and Elkington	477½	2,111 4 3
8 Bankart and Sons	120	338 1 0
9 Copper Miners' Co.	400½	2,002 18 3
10 Charles Lambert	192	334 17 6
11 Newton, Keates & Co.	87	463 16 0
12 Sweetland, Tuttle & Co.	24	224 8 0
13 Neath Copper Co.	173½	1,077 3 3
Total	3869	£19,295 16 6

Average Produce, 8¾.
Quantity of Fine Copper, 255 tons, 18 cwt.

Average Standard £117 0 0
Average Price per ton 5 0 0

Copper Ores.

Sampled Jan. 28, and sold at Tabb's Hotel, Redruth, Feb. 12.

Mines.	Tons.	Purchasers.	Price.
West Basset	62	1, 10	£3 9 0
	61	6, 7, 9	9 5 6
	60	9, 11	6 2 6
	59	5	3 11 0
	58	7	5 2 6
	53	6	3 18 6
	44	1, 5, 9	11 18 0
	43	11	4 5 0
	32	7	5 19 6
	28	1	3 17 0
Levant	82	5	4 12 0
	79	1, 5	9 14 6
	67	12	1 3 6
	63	9	5 2 0
	45	1	7 10 0
	2	1	14 8 6
Carn Brea	60	2, 7	3 13 6
	55	10	3 0 0
	52	9, 11	4 3 6
	48	4, 6	7 4 0
	47	13	7 2 0
	38	7	3 13 6
Par Consols	61	2, 6	6 16 0
	60	1	7 10 6
	59	2	5 16 0
	53	1, 3	3 10 6
Botallack	87	1	6 8 0
	56	1	7 14 6
	33	9	3 17 0
Prosper United	87	2, 4, 6	4 18 0
	33	12	1 7 6
	23	7	2 8 6
	13	9	4 2 0
Pendeen Consols	78	1, 4, 6	3 1 6
	46	5	3 9 0

Mines.	Tons.	Purchasers.	Price.
Pendeen Consols	21	7	£2 17 0
	3	1	20 0 0
Wheal Anna	65	4, 6	4 14 6
	54	13	6 8 0
	17	1	2 14 6
East Carn Brea	80	7	5 7 0
	50	7	8 0 0
Great South Tolgus	50	6	8 10 0
	45	9	4 7 0
	29	3	9 17 0
Copper Hill	51	1, 3, 5	7 12 0
	39	10	1 3 6
	31	5	1 17 0
Treloweth	59	8	4 4 0
	26	1	5 4 6
	15	1	12 5 6
West Fowey Consols	94	13	6 15 0
Rosewarne Consols	37	1	6 5 6
	31	1, 3	5 3 6
	14	1	11 18 6
New Treleigh	45	7, 10	1 17 6
	35	9	3 6 0
Wheal Buller	55	3, 12	2 7 6
	13	3	9 6 6
Great Wheal Alfred	42	5	1 14 0
East Alfred Consols	40	1, 5	3 5 6
Rosewarne United	18	8	3 7 0
	14	3	8 13 6
	4	3	6 10 0
Camborne Consols	10	3	8 10 0
Wheal Unity Consols	8	13	7 15 6
South Dolcoath	8	1	5 14 6
Cook's Kitchen	7	5	3 0 0
Wheal Tremayne	3	1	9 2 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
West Basset	500	£2,867 5 0
Levaut	338	1,912 17 0
Carn Brea	300	1,421 11 6
Par Consols	233	1,395 6 6
Botallack	176	1,116 9 0
Prosper United	156	580 15 0
Pendeen Consols	148	518 8 0
Wheal Anna	136	699 1 0
East Carn Brea	130	828 0 0
Great South Tolgus	124	906 8 0
Copper Hill	121	490 15 6
Treloweth	100	567 15 6

	Tons.	Amount.
West Fowey Consols	94	£634 10 0
Rosewarne Consols	82	559 11 0
New Treleigh	80	199 17 6
Wheal Buller	68	251 17 0
Great Wheal Alfred	42	71 8 0
East Alfred Consols	40	131 0 0
Rosewarne United	36	207 15 0
Camborne Consols	10	85 0 0
Wheal Unity Consols	8	62 4 0
South Dolcoath	8	45 16 0
Cook's Kitchen	7	21 0 0
Wheal Tremayne	3	27 6 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount
1 Vivian and Sons	591½	£3,928 9 5
2 Freeman and Co.	148½	801 19 0
3 Grenfell and Sons	156½	1,007 9 3
4 Crown Copper Co.	111½	548 8 3
5 Sims, Willyams, & Co.	358½	1,648 9 5
6 Williams, Foster & Co.	256½	1,577 8 7
7 Mason and Elkington	364 5-6	1,912 15 1
8 Bankart and Sons	77	308 2 0

	Tons.	Amount.
9 Copper Miners' Co.	280	£1,468 6 6
10 Charles Lambert	147½	359 19 3
11 Newton, Keates & Co.	99	475 1 0
12 Sweetland, Tuttle & Co.	127½	189 8 3
13 Neath Copper Co.	203	1,376 0 0
Total	2940	£15,601 16 0

Average Produce, 7¼.
Quantity of Fine Copper, 208 tons 7 cwts.

Average Standard £113 13 0
Average Price per ton 5 6 0

Copper Ores.

Sampled Feb. 4, and sold at the Royal Hotel, Truro, Feb. 18.

Mines.	Tons.	Purchasers.	Price.
Devon Great Consols	153	10	£0 16 6
	131	8	4 4 6
	129	1, 6	4 19 6
	124	1	4 0 0
	121	5	4 10 6
	119	2, 5, 9	4 4 0
	117	1	4 4 6
	116	5	3 3 0
	114	12	3 5 6
	112	5	4 2 6
	111	9	4 10 6
	107	3	9 2 6
	106	3	4 6 0
	97	3, 5	4 6 6
	94	5	4 2 6
	86	1	3 2 6
	82	3	9 6 6
	78	9	4 3 0
	77	10	1 18 6
	60	13	4 0 6
	59	7	3 14 0
	35	10	1 14 0
Phœnix Mines	88	1	2 1 6
	87	7,9	5 11 0
	76	6	3 7 6
	74	7	3 10 6
	72	1, 12	2 5 0
	55	12	1 19 6
	49	5	1 6
East Caradon	86	1, 6	4 6 6
	77	6	4 9 6
	74	1, 6	7 0 6
	73	5	6 13 0
	61	5, 9	3 17 6
	58	12	4 0 6
	51	5	7 12 0
Marke Valley	88	9	3 17 0

Mines.	Tons.	Purchasers.	Price.
Marke Valley	86	8	£4 4 6
	81	8	3 14 6
	72	9	4 2 0
	47	1	2 2 6
	36	8	1 9 6
Devon and Cornwall	91	10	1 3 6
	72	10	1 7 6
	59	9	1 12 6
	49	2	4 15 6
	29	1, 2	11 11 6
Bedford United	106	8	3 18 0
	98	13	3 14 6
Wheal Crelake	70	3, 11	4 12 6
	57	2, 3, 7	2 3 6
	41	11	3 16 6
Wheal Yarner	82	5	2 7 0
	50	12	3 3 6
Wheal Emma	57	8	3 3 6
	46	4, 6	5 13 0
	27	1, 5	1 13 6
Wheal Friendship	69	2, 6	7 1 6
	52	1, 6	10 8 6
North Robert	50	7	1 3 6
	36	11	5 11 6
Brookwood	64	8, 13	2 16 6
	13	1	7 16 6
Wheal Arthur	52	7	1 18 0
	12	2	4 0 6
Wheal Crebor	54	4, 6	4 2 0
Sortridge Consols	29	2	5 2 0
	24	7	6 1 0
Fursdon	23	10, 12	2 3 6
	11	12	5 12 6
Collacombe	22	7	2 12 6
Hawkmoor	20	3	3 7 6
Tavy Consols	17	3	2 2 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2,228	£9,326 4 6
Phœnix Mines	501	1,520 16 0
East Caradon	480	2,579 5 0
Marke Valley	410	1,452 1 0
Devon and Cornwall	300	871 9 0
Bedford United	204	778 9 0
Crelake	168	604 11 0
Wheal Yarner	132	351 9 0
Wheal Emma	130	486 2 0
Wheal Friendship	121	1,030 5 6

	Tons.	Amount.
North Robert	86	£259 9 0
Brookwood	77	282 10 6
Wheal Arthur	64	147 2 0
Crebor	54	221 8 0
Sortridge Consols	53	293 2 0
Fursdon	34	111 18 0
Collacombe	22	57 15 0
Hawkmoor	20	67 10 0
Tavy Consols	17	35 14 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	709½	£2,952 11 3
2 Freeman and Co.	197½	1,050 0 6
3 Grenfell and Sons	434½	2,712 19 9
4 Crown Copper Co.	50	240 13 0
5 Sims, Willyams & Co.	820	3,373 11 4
6 Williams, Foster & Co.	428½	2,202 8 10
7 Mason and Elkington	343½	1,122 8 0
8 Bankart and Sons	529	1,956 8 6
9 Copper Miners' Co.	511½	£2,042 13 4
10 Charles Lambert	439½	564 17 9
11 Newton, Keates & Co.	112	519 8 0
12 Sweetland, Tuttle & Co.	335½	1,040 1 3
13 Neath Copper Co.	190	696 19 0
Total	5101	£20,477 0 6

Average Produce, 5¼.
Quantity of Fine Copper, 287 tons 5 cwts.

Average Standard £120 2 0
Average Price per ton 4 0 6

Copper Ores.

Sampled Jan. 14, and sold at Swansea Feb. 3.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Cobre	105	13¾	7	£10	15	0
	103	14	7	10	18	6
	88	14¼	6	10	16	0
	100	14¼	3	11	1	0
	78	14¼	3	10	18	6
	48	24	5	19	2	6
	43	23½	7	19	2	0
	10	56	5	44	12	0
	8	58½	5	45	8	0
	16	31¾	5	23	17	6
	99	13¾	13	10	12	0
	98	13¾	13	9	19	6
	56	13¾	3	10	0	0
	29	13	1	9	15	0
	66	30¾	2, 7	24	4	0
Chili	53	24½	2	20	6	0
Chili	52	24½	15	£20	4	6
	51	24½	2, 7	20	5	0
	50	24½	9	20	4	6
Knockmahon	66	13¾	3	11	2	6
	62	13¾	13	10	18	6
Liverpool Slag	111	3½	2	1	15	0
Lisbon	39	26½	6	20	7	0
	2	29¼	6	21	10	0
	10	6½	6	4	17	0
	1	5	6	3	17	0
English & Canadi.	17	27	10	21	7	6
	12	44½	10	34	15	6
British Regulus	29	33	10	26	7	6
New Cornwall	19	24½	15	19	16	0
	3	10¼	3	5	8	0
Mount Rose	1	37	15	30	4	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Cobre	947	£12,558	19	6
Chili	206	4,171	12	0
Knockmahon	128	1,411	12	0
Liverpool Slag	111	194	5	0
Lisbon	52	889	0	0
English and Canadian	29	£780	13	6
British Regulus	29	764	17	6
New Cornwall	22	401	8	0
Mount Rose	1	30	4	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Copper Miners' Co.	29	£282	15	0
2 Freeman and Co.	222½	2,585	2	6
3 P. Grenfell and Sons	303	3,276	12	0
4 Crown Copper Co.	—	—		
5 Sims, Willyams & Co.	84	2,152	4	0
6 Vivian and Sons	138	1,796	8	0
7 Williams, Foster & Co.	309½	4,390	6	6
8 British and For. Copper Co.	—	—		
9 Mason and Elkington	50	1,011	5	6
10 Bankart and Sons	58	£1,545	11	0
11 Charles Lambert	—	—		
12 Ravenhead Copper Co.	—	—		
13 Sweetland, Tuttle & Co.	259	2,704	6	0
14 Jennings and Co.	—	—		
15 Neath Copper Co.	72	1,458	2	0
Total	1525	£21,202	11	6

Sundry Copper Ore Sales.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Feb. 5.	Lot 1 (ex John Peile)	70	17 17 0	St. Helens's Co.	
	2 ditto	70	17 13 6	Newton, Keates & Co.	
	3 ditto	70	17 17 0	St. Helen's Co.	
	4 ditto	70	17 14 0	Sims, Willyams & Co.	8,925 5 0
	5 (C. Clarke)	67	19 15 0	ditto	
	6 ditto	67	19 15 0	ditto	
	7 ditto	66	19 15 0	ditto	
„ 13.	Lot 1 (ex Arcano)	65	19 5 0	Sims, Willyams & Co.	
	2	65	19 6 6	ditto	
	3	65	19 1 0	Co. of Copper Miners	
	4	65	18 19 9	ditto	9,973 2 3
	5	64	19 3 3	ditto	
	6	64	19 4 9	ditto	
	7	69	18 7 6	Evans and McBryde	
	8	69	18 7 6	ditto	

The Worthing Mining Company Limited (South Australia) have sold during the past year egulus to the value of £16,859 10*s.* 9*d.*

Copper Ores.

Sampled Jan. 28, and sold at Swansea, Feb. 17.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Cobre	68	13½	6	£10	0	0
	54	13½	6	10	4	0
	53	20¾	8	16	5	0
	51	20	1, 3	15	15	0
	47	20¾	3	15	17	0
	107	13½	7	10	5	0
	104	13½	7	10	5	0
	82	13⅜	3, 7, 15	10	5	0
	70	13½	7, 15	10	5	0
	49	23½	2	18	0	0
	52	34⅜	3	27	5	0
	13	67½	3	53	0	6
	11	69	8	53	1	6
Ookip	47	34½	8	27	17	0
	45	34½	2, 7	27	15	0
	44	34	5	27	2	6
	47	36½	5	29	14	6
	42	36	1	28	15	6
	45	28½	10	22	10	6
	29	32	10	26	2	6
Wheal Maria	27	38½	14	31	6	0
	9	35	5	28	2	0
	1	34	6	27	0	0
Chili	57	25½	9	20	5	6
	56	26⅜	1	21	4	0
	55	25½	1	20	2	0
Chili	54	25	5	£20	1	0
Knockmahon	115	11½	6	9	8	0
	95	10½	6	8	5	0
Victor Emanuel	56	7½	15	5	18	0
	18	3½	7	2	8	6
	4	18½	5	14	4	0
	6	12½	7	9	15	6
	2	6½	7	4	9	0
Genoa (P. M. C.)	18	13½	3, 7	10	7	0
Berehaven	95	11½	6	9	6	0
Great Northern / South Australia	24	21½	6	16	12	0
	8	32½	6	26	1	0
	7	16½	3	13	0	0
	17	26½	3	20	3	0
	4	21½	6	16	7	0
African (C. M.)	33	20½	6	15	18	0
	44	15½	3	12	9	6
	19	16½	3	13	3	0
	11	15½	3	12	5	6
	11	16½	3	13	3	0
	2	20	10	16	2	6
	1	20½	2	16	8	0
London Slag	24	3½	5	1	10	0
London	6	22½	2	18	0	0
	1	17	2	13	0	0
Precip. (A. K. T.)	4	67½	6	50	0	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Cobre	761	£10,933	3	0
Ookip	299	8,128	1	6
Wheal Maria	37	1,125	0	0
Chili	222	4,531	1	6
Knockmahon	210	1,864	15	0
Victor Emanuel	96	498	8	0
Genoa	18	186	6	0
Berehaven	95	£883	10	0
Great Northern of South Australia	193	1,630	9	0
African	88	1,127	1	6
London Stag	24	36	0	0
London	7	121	0	0
Precipitate	4	200	0	0

EACH COMPANY'S PURCHASE.

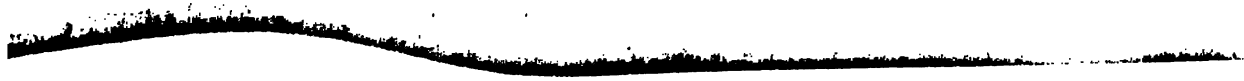
		Tons.	Amount.		
1	Copper Miners' Co.	178½	£3,902	17	6
2	Freeman and Co.	79½	1,643	15	0
3	Grenfell and Sons	269 5–6	4,448	17	4
4	Crown Copper Co.	—	—		
5	Sims, Willyams & Co.	182	4,018	19	6
6	Vivian and Sons	501	5,402	19	0
7	Williams, Foster & Co.	330–5–6	3,630	7	10
8	British and For. Copper Co.	124	3,443	7	0
9	Mason and Elkington	57	1,155	13	6
10	Bankart and Sons	76	£1,803	10	0
11	Charles Lambert	—	—		
12	Ravenhead Copper Co.	—	—		
13	Sweetland, Tuttle & Co.	—	—		
14	Jennings & Co.	27	845	2	0
15	Neath Copper Co.	118½	969	6	4
	Total	1,944	£31,264	15	6

Black Tin Sales.

Date.	Mines.	Tons.	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Jan 28.	South Carn Brea	5	3	2	4	60	12	6	Bissoe Co.	617	9	4
	,,	5	0	0	19	60	12	6	Chyandour Co.			
,, 29.	Great Wheal Fortune	20	0	0	3	—			Mellenear Co.	1427	5	4
Feb. 3.	Great Wheal Busy	21	2	0	4	—			—	1230	6	4
,, 5.	Wheal Hearle	3	11	2	10	62	10	0	Bolitho and Sons	223	14	0
,, 6.	Worvas Downs	2	17	3	23	—			—	176	3	3
,, 7.	Redmoor	4	15	0	0	64	10	0	Treriffe Co.	306	7	6
,, 12.	Gurlyn	6	1	0	18	62	10	0	Chyandour Co.	378	12	6
,, 14.	Great Wheal Vor	27	3	0	3	—			—	1868	5	0
	South Carn Brea	5	17	1	15	60	15	0	—	356	11	0

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Jan. 20.	Carmarthen United	30	14 3 0	Sims, Willyams & Co.	434 10 0
„ 21.	North Laxey	20	13 13 0	Stock & Co.	273 0 0
	Dyfngwm	35	13 4 0	Newton, Keates & Co.	462 0 0
	Llanerchyraur	10	15 1 0	ditto	150 10 0
„ 24.	Chiverton	51	19 13 0	Stock & Co. / Treffry's Trustees	1578 3 0
	„	50	11 10 6		
„ 29.	Maesyaafn	50	13 11 0	Adam Eyton	677 10 0
	Mount Pleasant	10	12 17 6	Walker, Parker & Co.	126 15 0
	Hendre Ucha	34	13 12 6	ditto / ditto	612 0 0
	„	10	14 17 6		
	Bryngwyn	8	13 16 6	Newton, Keates & Co. / Walker, Parker & Co.	220 12 0
	„	8	14 17 6		
	Roman Gravels	25	13 16 6	Newton, Keates & Co.	345 12 0
	Creetown	2¼	12 7 6	Walker, Parker & Co.	34 0 7½
	Minera Union	13	13 7 6	Adam Eyton	173 17 6
	Pool Park	15	13 7 6	Newton, Keates & Co.	206 12 6
	Foxdale	100	22 13 6	Walker, Parker & Co.	2257 10 0
„ 31.	Trelawny	60	27 0 0	Stock & Co.	1620 0 0
Feb. 2.	East Logylas	50	13 3 6	Panther Co.	634 15 0
	Glogfach	60	15 15 6	Treffry's Trustees	948 10 0
	Cwmystwith	100	13 6 6	Sims, Willyams & Co.	1332 0 0
	Goginan	20	18 6 0	ditto / Newton, Keates & Co. / Walker, Parker & Co. / Treffry's Trustees / ditto / R. Michell & Son	447 12 0
	„	5	16 6 6		
„ 3.	Holmbush	20	15 7 6		
	„	30	2 0 6		378 5 0
„ 6.	Wheal Mary Ann	55	28 1 6		
	„	30	13 8 6		1946 17 0
	Minera	100	13 15 0	Sims, Willyams & Co.	
	„	100	13 13 0	Walker, Parker & Co. / ditto / Sims, Willyams & Co. / Walker, Parker & Co. / Sims, Willyams & Co. / Walker, Parker & Co. / Panther Co. / ditto / Walker, Parker & Co. / Panther Co.	
	„	50	13 13 0		
	„	50	13 13 0		
	„	50	13 13 0		
	„	100	13 12 0		8163 18 0
	„	50	13 11 0		
	„	50	13 11 0		
	„	20½	13 11 0		
	„	20½	13 11 0		
	„	9	11 15 0		
„ 7.	Silver Mountain	10	13 9 0	Sims, Willyams & Co.	134 10 0
„ 10.	Tamar	47	17 16 6	—	837 15 6
„ 12.	Talargoch (Maesyrerwddu)	70½	14 17 6	Walker, Parker & Co. / Adam Eyton	1864 13 9
	„ (Coetia Llys)	60	15 2 0		
	Deep Level	12	13 11 0	ditto	162 12 0
	Brynford Hall	10	12 16 6	Walker, Parker & Co.	123 5 0
	Rhosesmor	7	13 1 6	Adam Eyton	91 10 0
	Parry's	31	13 18 6	Walker, Parker & Co.	421 13 0
	Bryn Gwiog	60	14 14 6	ditto	883 10 0
	Long Rake	10	14 1 0	Newton, Keates & Co.	140 10 0
	Cefn Cilcen	5	13 16 6	ditto	69 2 6
	Merllyn	6	12 10 0	ditto	75 0 0
	Grosvenor	3	11 17 6	Walker, Parker & Co.	35 12 6
	Llangynog	31	13 12 0	Newton, Keates & Co.	421 12 0
	Llanerchyraur	20	14 13 0	ditto	283 0 0
	Roman Gravels	21	13 16 6	Walker, Parker & Co.	290 6 6
	Lower Park	5	13 12 6	Newton, Keates & Co.	69 2 6
„ 16.	Frongoch	55	13 1 0	Panther Lead Co. / Walker, Parker & Co.	1402 15 0
	„	53	12 18 6		
	East Darren	75	16 8 0	Michell and Son	1230 0 0
	Cwm Erfin	25	16 10 6	Treffry's Trustees / Newton, Keates & Co.	290 17 0
	„	30	15 18 6		
	Bronfloyd United	50	14 1 6	Panther Co.	703 15 0
	Clara United	14	12 6 0	ditto	172 4 0



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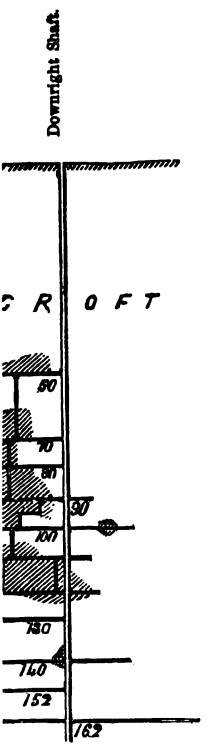

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MINING AND SMELTING MAGAZINE.

APRIL, 1863.

The Iron Manufacture of the Centre of England.

(For Merchant Bars and Plates.)

By MM. Gruner and Lan.

(Abstracted from the *Annales des Mines*, 5th series, vol. xx, p. 583.)

General Considerations. Importance of the District.

From what has gone before, we have seen that Scotland produces *black* pig for foundry use, and Wales *white* pig for rails. We shall now see that the special make of the central district is *grey* pig for merchant bars and plates. In the two former districts both the pig-iron and the rails are manufactured by a relatively small number of works, in large quantities, identical in quality.

In the central district much smaller, but an infinitely greater number of works turn out the greatest variety of products, from the raw pig up to thin plates and the finest wire. The works of this district are, besides, dispersed over a very large area; for, although most of them are concentrated in a small space, with the town of Dudley for a centre, still we find them at all points of the vast coal-basin which skirts on all sides the great watershed of England, and more especially in the five counties of Stafford, Worcester, Derby, Salop, and the West Riding of York. The extreme concentration of the iron-works round Dudley in South Staffordshire is, besides, very recent; dating only 30 to 40 years back at most.

Thus, in 1806, the number of blast-furnaces in Staffordshire and Worcestershire combined was only forty-two, while in Shropshire alone at that period there were forty-two, in Derbyshire seventeen, and in the West Riding of Yorkshire twenty-eight, in all eighty-seven. Twenty years later, in 1826, the number of furnaces had increased to one hundred and eight in the two first-named counties,

while it only amounted to from eighty-seven to eighty-nine in the three others; and at present, or rather in 1857, we find:—

	Blast-Furnaces.
In the environs of Dudley, in South Staffordshire, comprising part of Worcestershire	180
In North Staffordshire	27
Total	207
In Shropshire	31
In Derbyshire	34
In the West Riding of Yorkshire	36
Total	101

During 50 years, therefore, the number of blast-furnaces, or iron-works generally, has not materially varied in Shropshire and in the West Riding, while it has doubled in Derbyshire and more than quintupled in South Staffordshire. The present siderurgical importance of the environs of Dudley will be seen from the fact that, in 1857, besides the one hundred and eighty furnaces already mentioned, Mr. Robert Hunt enumerates, over an extent of at most 50 square miles, more than four hundred coal and iron mines, and one hundred and nine forges, containing two thousand and thirty-seven puddling furnaces.

The details which we shall give as to the make of grey forge-pig relate therefore more specially to South Staffordshire, with which, in fact, we shall principally deal. Still the works of Shropshire, North Staffordshire and Derbyshire are situated under almost identical conditions, except that their products are generally more highly estimated, owing to the care taken in their manufacture. As to the West Riding, comprising especially the works of Lowmoor and Bowling, in the neighbourhood of Bradford, it is well known that their products are of very superior quality. For these reasons we shall confine ourselves here to the Dudley district of South Staffordshire, and to that of Lowmoor and Bowling in the West Riding. We shall pass over the works of Derbyshire, Shropshire, and North Staffordshire, as, by their situation as well as their products, they occupy an intermediate position between the two districts just named.

But before passing to a special description of these two districts, we may say a few words on the central coal-basin, upon which are situated, not only the numerous iron-works we have mentioned, but also the principal seats of industrial manufacture in the United Kingdom: the hardware of Birmingham, the steel works of Sheffield, the foundries of Leeds, the cotton mills and machine works of Manchester and Oldham, the woollen manufactories of Bradford and Halifax, and the silk and lace manufactories of Coventry and Nottingham.

In the centre of England, towards the southern extremity of the Penine chain, rises up the massive limestone of Derbyshire, about which the Millstone Grit extends on all sides, succeeded by the Coal-measures, properly so called. These latter naturally group them-

selves into two branches, that of the east and that of the west, skirting either flank of the Penine chain. The eastern branch extends from Derby as far as Leeds, increasing in width from south to north, and terminating beyond Bradford at a great east and west fault, which throws up the lower beds considerably. Along this range of Coal-measures are established the iron-works of Derbyshire (Alfreton, Butterly-park, Codnor, &c.), the steel-works of Sheffield, the foundries of Leeds, and the iron-works of Lowmoor and Bowling. The western branch also widens from south to north, and, like the first, its course is parallel to the Penine chain, for a length of from 60 to 66 miles; terminating near Burnley, at the great Bradford and Halifax fault. Along this zone are found the works of North Staffordshire, and the numerous industrial establishments of Manchester, Oldham, and St. Helen's.

The thickness of the Coal-measures is estimated on an average at from 4 to 5,000 feet, with from 50 to 60 feet of workable coal in the richest portions. Its extent, according to Messrs. Taylor and Hunt, is 1,010 square miles to the east of the Penine chain, and 600 square miles to the west, making a total of 1,610 square miles. But this does not comprise its entire area, for, on the east, as on the west, it dips under the more recent deposits of the Permian and Triassic formations, without it being possible to fix a possible limit to its subterranean extent, except on the western side, where, on the borders of Wales, the coal beds crop out from under the New Red Sandstone, forming a series of patches, apparently isolated, upon which are established the works of Shropshire and of North Wales.

Thus, in extent, the central coal-basin is by far the most important in the United Kingdom; and it is equally so in its production which reaches to nearly a moiety of the total yield of the United Kingdom—65 millions tons in 1858.

In that year:—

	Tons.
The eastern branch yielded	12,262,900
The western branch	10,470,450
And South Staffordshire	6,811,640
Total production of the central basin ..	29,544,990

Almost the whole of this was absorbed for home consumption, for the exports, properly so called, of the central basin did not reach 750,000 tons.

Towards the southern extremity of the Penine chain, the two branches of the central basin (that of the east and that of the west) dip likewise under the Trias, joining in depth and reappearing at the surface round the Silurian rocks of Dudley, near Birmingham—forming the southern part of the central basin, or the district proper of South Staffordshire. In this locality the carboniferous system is much less developed than in the environs of Manchester or of Sheffield. The Carboniferous Limestone and the Millstone Grit have entirely disappeared; so that the coal-formation proper, itself reduced to 1,000 feet in thickness, rests directly on the Upper Silurian rocks. The intermediate formations do not reappear under the Coal-measures till near the borders of Wales, where, first the

Old Red Sandstone, and then the Carboniferous Limestone, gradually develope themselves approaching the Bristol Channel. The coals of the central district are all more or less dry and long-flamed. It is only in Yorkshire, near Sheffield, that they become really caking.

The South Staffordshire District.—Of any portion of the English coal-formation or even of the carboniferous deposits of the whole world, the narrow district of South Staffordshire includes, in proportion to its extent, the greatest number of mines and works. It is the Black Country *par excellence*. It maximum length from south to north is but 26 miles, and its greatest width 9 miles; but on an average its length cannot be calculated at more than from 18 to 20 miles, or its width at more than 5 miles. Thus its area does not exceed from 90 to 100 square miles—and even the portion really covered with works does not exceed 50 square miles; which is about equivalent with the basin of the Loire.

In the centre of this district is the town of Dudley, with a population of 50,000; but it also includes six other towns equally important—Wolverhampton, Bilston, Stourbridge, &c.; besides sixteen very large villages, which elsewhere would be considered towns, and among which are situated the one hundred and nine forges, the one hundred and eighty blast-furnaces, and the four hundred mines mentioned above.

South Staffordshire is a slightly undulating country with an average altitude of not more than 400 or 500 feet, that of its highest hills scarcely reaching from 7 to 900 feet. Notwithstanding this trifling elevation the Dudley district is traversed through its length by the great English watershed, which here passes from the heights of the Penine chain towards the plains of Worcestershire. This situation of course precludes the possibility of there being any stream of importance, and still more so any navigable rivers. We only find the sources of the Stour which flow by the Severn into the Bristol Channel, and those of the Rea which, passing Birmingham, fall into the North Sea. But what nature has denied the hand of man has accomplished. Two lines of canal traverse the district,—the Birmingham Canal to the east, and the Stourbridge canal to the west,—and, in their numerous ramifications, pass the greater portion mines and works. Besides, several railways run through it, and, like the canals, put it in direct communication both with Liverpool and the ports of the Bristol Channel, and with London and the ports of the North Sea. Still, owing to the inland situation of the district, the cost of carriage to the nearest ports is at least four times as great as in the Welsh and Scotch districts; a difference which partly explains the special character of the iron industry of Staffordshire.

1. *Coal Basin.*—The South Staffordshire Coal-measures, according to the Geological Survey, are composed, in their most complete development, of three groups:—

1. Upwards, the Halesowen sandstones, of from 2 to 300 feet in thickness.

2. Under them, the Red Coal-measure clays, of 300 feet in thickness.
3. At the bottom, the coal-beds proper, of from 5 to 600 feet, which alone contain the workable seams.

The upper sandstones are of various colours, and sometimes pass into a true conglomerate. They are principally met with to the south of Dudley, and especially round the small town of Halesowen. The Red Coal-measure clays are of a deep purplish red colour, sometimes blue or green, and are worked at various localities for the manufacture of common bricks. The two upper groups do not contain any coal-seam of importance. The coal is confined exclusively to the lowest group, which is principally composed of grey or black argillaceous beds. Sandstones are rare and very fine-grained, and even when they do appear at certain points they thin out in short distances.

In the northern and central parts of the basin the workable seams are 7 or 8 in number. The six principal ones, taking them from the top downwards, have the following thicknesses :—

Brooch Coal	4	including the partings.
Thick or Ten yards Coal	30	„
Heathen Coal	3 to 4	„
New Mine Coal	8	„
Fireclay Coal	7	„
Bottom Coal	12	„
Total thickness	65	„

Or about from 55 to 60 feet of coal proper.

The South Staffordshire basin is distinguished from any other English coal-field by the exceptional development of the Thick Coal, and the remarkable variations it undergoes, in which respect it rather resembles the coal deposits of the central plateau of France. This seam continues without notable change round Dudley, although even there its thickness varies between 20 and 36 feet; but towards the west and north it divides into several branches from the gradual thickening of its numerous partings. Beyond Bilston and Wolverhampton its various beds form twelve or fifteen entirely distinct seams, occupying, together with the sterile interstratifications, a total thickness of 300 feet. Thus, while we find seven or eight seams in the southern part of the basin, the number reaches twenty-one towards the northern part, but without the total thickness of coal being sensibly increased, except perhaps a little between Bilston and Wolverhampton, where the total workable thickness reaches 70 feet.

As regards direction and inclination, the South Staffordshire basin presents frequent changes. To the south of Dudley, near Halesowen, a general dip towards the south may be observed, but northward the beds rise on all sides towards the Silurian rocks, and crop out successively. It is in this portion of the basin that we find the greatest concentration of old workings, and the surface is turned over to an extent that can scarcely be imagined. In this part of the district the six principal seams are so close together that they do not occupy a thickness of more than from 300 to 350 feet, so that a

sixth of the entire thickness is composed of workable coal. In order to arrive at the full extent of the excavations made in the working away we must add the bands of ironstone, the total thickness of which, including the sterile partings that have to be taken away, varies from 12 to 18 feet.

This extreme richness, accumulated in such a narrow thickness and over such a small space, has, for that reason, been the cause of an extraordinary amount of waste.* On an average not more than half the coal is made available, and even at present the greater part of the small is lost. Thus in a colliery working on the Thick Coal of Bilston, relatively well-managed, which contained from 40 to 45,000 tons of coal per acre, the most recent operations have only in reality yielded :—

	Tons.
Large coal	20,974
Lumps	4,227
Slack	6,292
Total	31,493

And even this result must be considered as unusually advantageous, for in general the produce of the Thick Coal, calculated according to the average of several acres, is notably less.

It is impossible to fix the reserve of coal still available in the Staffordshire basin. The surface is so covered with various buildings, and is so riddled underground by numerous old ill-managed workings, that there is no knowing what to calculate. Compared with the other English basins it may almost be said to be exhausted. Still the quantity already taken away cannot exceed from 150 to 200 million tons.† Now from the data given above it would appear that the total original resources of the basin amounted to a thousand million tons, so that there still remain 800 million. If this estimate appears exaggerated, when we consider the innumerable buildings which cover the soil, it must not be forgotten, on the other hand, that we only take into account that portion of the basin not covered by more recent formations. The coal-formation of South Staffordshire is, in fact, bounded by faults, which throw down the Coal-measures under the Permian and Triassic formations. Its real extent far exceeds its apparent area; and although, according to Professor Ramsay, the Permian formation of this district has an average thickness of 1,500 feet, and the Trias of nearly 2,000, it is

* Compare Dr. Percy's Metallurgy, page 103.—ED. "It is no libel on South Staffordshire to assert that this magnificent bed of coal has been most barbarously treated. The pits have generally been worked by contractors, called butties, under the superintendence of viewers, called ground-bailiffs. In consequence of the rapacity and rascality of many of the former, and the ignorance, inattention, and fraudulent connivance of many of the latter, an enormous amount of coal has been irremediably lost to the nation. Even at the present day the South Staffordshire colliery-viewers are frequently very imperfectly educated for their responsible duties, and the system of colliery mismanagement which still extensively prevails in this part of the country is a disgrace to the age."

† About 1830 the annual yield amounted to from 1,200,000 to 1,500,000 tons, and at present the average yield is 5 million tons.

not less true that at many points the coal-seams are workable under these secondary formations, as in the basins of the Moselle, of Ronchamp, of Saone et Loire, &c. Thus the South Staffordshire basin, although already largely worked away, and supplying an enormous local consumption, is still in a position to continue this supply to its numerous works for a century at least.

The cost of getting the coal in this district is, however, higher than in other parts of the United Kingdom. For a given surface the number of proprietors is much greater, and on this account the royalty is higher, and the accessory expences heavier. Thirty years ago the authors of the *Voyages Métallurgiques* gave 6*s.* per ton as the average price of large coal delivered at the works. At present the price is 7*s.* 6*d.*—showing, as in Wales, an increase of 25 per cent. The royalty, which was formerly 6*d.*, now varies from 9*d.* to 1*s.* 6*d.*, and reaches sometimes even to 3*s.* In general the royalty is estimated at about one-eighth of the selling price; but in certain mines to the west of Dudley it reaches one-fifth, if not one-fourth. The following are some examples of the cost of raising coal in this district. In the seam called the Brooch Coal, which furnishes a very hard coal, much in request for domestic purposes, the cost is as follows:—

	s.	*d.*
Getting	4	3
Deadworks	2	0
Royalty	0	9
Total	7	0

	s.	*d.*
Cost-price per ton of large coal, without interest of capital	7	0
„ Lumps	4	0
„ Slack	3	3

In the Heathen Coal the cost is:—

	s.	*d.*
Getting	2	7
Deadworks	2	0
Royalty	1	6
Cost-price of large coal	6	1

In the Thick Coal the cost is:—

	s.	*d.*
Getting	2	4
Deadworks	2	0
Royalty	1	6
Cost-price of large coal	5	10

To these prices must be added the cost of carriage from the collieries to the iron-works, from 6*d.* to 1*s.* We may remark as to these prices that, contrary to the custom followed in Wales and Scotland, the iron-masters of Staffordshire rarely calculate the coal at cost-price in estimating the cost of the pig and manufactured iron. In fact, in this district there are many iron-masters who do not own collieries, the two industries being often quite distinct. Indeed, even where they are combined, the large coal and lumps are charged at a profit of 1*s.* per ton: the slack alone is taken at cost price. Thus the average price of 7*s.* 6*d.* per ton of large, delivered at the works, includes in reality 1*s.* profit, and if we would compare the conditions of the South Staffordshire works with those of Wales we must calculate the cost at 6*s.* 6*d.* per ton. This is 1*s.* 6*d.* more than the average price at the Welsh works.

We give the current selling price of the principal varieties of coal in June, 1860, the coal being delivered in waggons or in boats on the mine:—

		s.	d.	
1. Brooch coal:—				
Large		8	0	For domestic purposes.
Lumps		5	0	
Slack		2	6	
2. Thick coal:—				
Large	Best	9	0	For domestic purposes.
	Second	8	0	
	Inferior	7	0	For puddling, heating, and blast-furnaces.
	For furnace	6	0	
Lumps		5	0	
Slack	Good	2	9	For boilers and heating the blast.
	Small	2	6	

The Staffordshire coals, like those of the Scotch districts, are essentially dry and long-flamed. They lose in distillation more than 40 per cent., and when carbonised in lumps yield only from 45 to 50 per cent. at the maximum of very badly agglomerated coke. As to the small it cannot be made into coke except by mixing it with pitch according to Mr. Blackwell's method. We need not refer specially to the methods for carbonising, which have not varied during thirty years. We shall only say that the cost of coke, made with lumps costing from 6*s.* to 7*s.*, delivered at the works, is on an average 15*s.*, of which 1*s.* is for labour and tools. The silver-white coke, which certain works procure from Yorkshire, costs 18*s.* per ton.

2. *Iron Ores.*—The iron ores treated in South Staffordshire are derived principally from the Coal-measures. Still there are introduced from year to year increasing quantities of various ores; and if the latter are not at present, as in Wales, in excess of the clay ores, they still furnish a third of the total production, while in 1830 the Coal-measure carbonates alone were treated.

The imported ores are of three kinds: the red hematites of Cumberland, Lancashire, and the Forest of Dean; the ores, more or less oolitic or hydro-oxidated, derived principally from the Jurassic formation of Northamptonshire; and lastly the schistose hydro-oxides of the Millstone Grit, worked at Froghall, in North Staffordshire. The quantity annually smelted in the works round Dudley is not exactly shown by the statistics of the Survey, but it may be approximately estimated. In 1858, for a production of 597,809 tons of pig-iron there was smelted:—

	Tons.	Per cent.
Coal-measure ores of South Staffordshire	959,000	@ 35
„ „ Warwickshire	29,500	„ 35
Froghall ores, with a small proportion of the calcined coal-measure ores of North Staffordshire	300,000	„ 45
Red hematites of Lancashire, Cumberland, &c.	125,000	„ 50
Various ores from the secondary formations	100,000	„ 40
Total	1,513,500	

This total would yield about 583,000 tons of pig-iron. The extra produce is derived from the forge cinders, which have lately been

added in small quantities in some works which sacrifice quality to cheapness. Preference is given to the cinders of the heating furnaces, and when the proportion does not exceed 5 per cent., the quality of the forge-pig is not injured.

As to the nature of these various ores, with the exception of the red hematites, they are more or less phosphoretted, and if their percentage exceeds that of the Coal-measure ores, they contain on the contrary less manganese. These foreign ores, excepting the red hematites, are not therefore of a nature to improve the quality of the Staffordshire pig-iron; and, in fact, the Shropshire pig-iron, obtained exclusively from Coal-measure ores, is more sought after.* In Staffordshire, as in Wales, the clay ore forms bands between the beds of coal in the Coal-measures proper; and it is also specially abundant in the lower part of the measures in question. Thus, few are met with in the Thick Coal, while four bands, two of them very important, are found at the base of the measures, under the Bottom Coal.

According to Mr. Beete Jukes† the total number of bands is fifteen; but all these are not workable, and besides, they are never all found to exist in one place; sometimes one and sometimes another thins out and disappears. In general not more than from six to seven bands can be calculated on in each working, and their total thickness, including the sterile interstratifications, varies from 12 to 18 feet, and the workable thickness from 5 to 8 feet. The richest ore deposits are round Bilston, to the north-west of Dudley, but even there the complete working of an acre of ground rarely yields more than from 11 to 12,000 tons of ore, equivalent with a total workable thickness of at most 4 feet. If this thickness seems low compared with the 5 to 8 feet we have mentioned, it is that the bands are rarely continuous, and in general, are formed rather by a succession of nodules. We see, then, that Staffordshire, like Wales, is less rich in iron ores than is commonly supposed on the Continent. The annual exhaustion is, besides, almost as rapid in the ore as in the seams of coal. Five million tons of coal are obtained yearly, against one million tons of ore; but this is precisely

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* The memoirs of the Geological Survey give the analyses of a great number of the Coal-measure ores of Staffordshire, made under the direction of Dr. Percy, at the School of Mines. According to these analyses the ores are generally composed of:—

	Per cent.
Protoxide of iron	52 to 40
Protoxide of manganese	·75 „ 1·50
Lime	1 „ 4
Magnesia	1 „ 2
Carbonic Acid	33 „ 31
Phosphoric Acid	·20 „ ·70
Iron Pyrites	— „ ·20
Water	1 „ 2
Clayey Residue, containing ½, or at most ½, its weight in Alumina	10 „ 15
	100

† Memoirs of the Geological Survey: the Iron Ores of Great Britain, part ii, p. 103.

the relation between the quantities of coal and ore available in the same extent of ground; which shows that if all the pig-iron actually produced in South Staffordshire were to be made from the Coal-measure ores of the district alone, it would be necessary to raise more ore than coal, in proportion to their respective available resources—that is to say, 1,750,000 tons instead of a million tons.

The cost price of the clay ores, excluding the mining profit, is almost the same in Staffordshire as in Wales, notwithstanding the different rate of royalty, which is from 1*s.* 6*d.* to 2*s.* instead of from 4*d.* to 6*d.*: the greater thickness of the bands, however, compensates for the increased royalty. The miners engaged in breaking earn on an average from 3*s.* 3*d.* to 3*s.* 6*d.* per day, and raise from 15 to 24 cwts. of ore, according to the nature of the band, instead of from 10 to 12 cwts. raised by a miner in Wales. In a mine near Bilston we found the following cost-price, being the average result of the working of seven bands:—

Per ton of 22 cwts., longweight (120 lbs. to the cwt.):—

	s.	*d.*
Getting	5	5
Deadworks	2	6
Royalty	1	9½
Total	9	8½

But to this price must be added, as in the case of coal, the mining profit. Generally from 2*s.* to 3*s.* or even 4*s.* is allowed for ores of superior quality, which brings the price to 13*s.* or 14*s.* And, in fact, common ores generally cost 12*s.*, and the superior from 15*s.* to 16*s.* per ton of 22 cwts., longweight. Subtracting the mining profit, we find on comparison that the price is much the same as in Wales. According to the authors of the *Voyages Métallurgiques* the cost of the ordinary ores thirty years ago, not including the profit, was 7*s.* 6*d.* per ton. The increase since that period has consequently been, as in the case of coal, about 25 per cent.; a less increase than in Wales, where we have found it amounted to 50 per cent. This difference explains the slower progress of the importation of ores into Staffordshire. The following are the prices of the imported ores:—

Red hematites of the North of England:—	*s.*	*d.*		*s.*	*d.*
Per ton of 20 cwts., shortweight (112 lbs. to the cwt.)					
on the spot	10	6	to	11	6
Carriage by railway	8	0	„	9	0
Total	18	6	„	20	6

Oxidised ores of Froghall (North Staffordshire):—	*s.*	*d.*		*s.*	*d.*
Per ton of 20 cwts., longweight, on the spot	8	0	to	9	0
Freight by canal or railway	7	0	„	8	0
Total	15	0	„	16	0

Northamptonshire ores:—	*s.*	*d.*		*s.*	*d.*
Per ton of 20 cwts., longweight, on the spot	5	0	to	5	0
Carriage by railway	7	0	„	8	0
Total	12	0	„	13	0

In South Staffordshire the Coal-measure ores are constantly calcined in heaps in the open air. This consumes from 10 to 15 per cent. of coal, and costs 8½*d.* per ton; but this cost is never distinguished from that of the blast-furnaces, excepting in the case of the Coal-measure ores of North Staffordshire, which are calcined on the mines themselves, and sold in that state to the South Staffordshire works.

3. *Limestones, Refractory Clay, Bricks, &c.*—The limestone is derived from the Silurian Limestone. This latter penetrates the Coal-measures on a line with Dudley and Wolverhampton, as well as to the east of the town of Walsall. It is worked opencast or by very shallow underground workings: in both cases the cost-price per ton is 2*s.* The refractory clay, very abundant in the Coal-measures, costs from 10*s.* to 12*s.* per ton. A thousand refractory bricks, weighing 3 tons, sell at from 52*s.* to 60*s.* according to their quality, semi-refractory bricks 25*s.*, and red bricks of good quality 20*s.*

On the Retorts used in the Making of Zinc.

By M. E. Gatellier, ingénieur civil des mines, ancien élève de l'Ecole Polytechnique.*

When we compare the yield obtained in the metallurgy of zinc with that which we get from ores of the other metals we are struck with its great inferiority. While in the cases of iron and lead the loss does not exceed 2 or 3 per cent. of metal, we are obliged, in order to obtain 100 kil. of zinc by any known method of reduction, to employ ores containing 126 kil. of that metal. To what is this attributable? Is it that the reduction is incomplete, or does it proceed from the imperfect methods of collecting the reduced metal?

These are the questions which I proposed to myself when I had been called to enter upon the reduction of zinc by the Belgian method, at one of the works of the Vieille Montagne Company. To solve them I had recourse to experiments. I wished, in the first place, to ascertain in what manner the zinc distributed itself in the products of reduction of a good-conditioned retort, that had remained some time in the furnace—in order to discover the proportionate loss of zinc in the residues and in the atmosphere.

Charge of the retort :—

	Kil.
4 kil. of Moresnet Calamine of 53 per cent.	2·12
4 kil. of Spanish Calamine of 51 per cent.	2·04
2 kil. of Calamine Residue ("sweep") of 42½ per cent...	0·85
Total Zinc charged	5·01

* *Des Inconvénients de la porosité des creusets employés à la fabrication du Zinc, et d'un moyen d'y remédier.—Annales des Mines*, 4th livraison, 1862. Tome ii, 6th series, p. 145.

Products of the Reduction :—

	Kil.
Metallic Zinc	2·915
0·725 kil. of Zinc fume of 94½ per cent.	0·685
0·9 kil. of "Crusts" { 0·6 kil. of 76 per cent.	0·456
0·3 „ 91 „	0·273
7·08 kil. of Residues of 8½ per cent.	0·618
Zinc incrusting the tube ("pipe-metal")	0·060
Total Zinc obtained in the different products ..	5·007

The loss of zinc in the atmosphere was thus 5·01 kil. — 5·007 kil. = 0·003 kil. Hence it follows that the loss by volatilisation was insignificant, while the loss in the residues amounted to 14 per cent. of the zinc produced. This of course shows a very imperfect reduction, due to the presence of the silicates of zinc which are only incompletely attacked. But still we may conclude from this experiment that we do not generally succeed in collecting all the zinc reduced; for if all the retorts were in the same conditions as the one operated with, the loss per 100 kil. of zinc produced would be 14 kil., instead of 26 kil., which constitutes the mean loss. Taking into consideration that all the retorts are not as well placed in the furnace as that in this experiment, and that all the furnaces are not always equally well heated, the loss might reach the maximum of 20 kil. in the most unfavourable conditions of heating. This maximum of loss results from a comparison of the yields obtained during certain days of good and bad heating.

The difference between the yield shown by this experiment and that really obtained, is due to the fact that all the retorts are not in equally good condition as that with which I operated. In the furnace we may distinguish three kinds of retorts, which do not yield their zinc in a satisfactory manner:—

1. Those which become cracked or perforated during the operation;
2. Those which, already cracked or perforated, had been restopped with clay;
3. New retorts.

As to the retorts perforated during the operation, that is an accident that cannot be avoided, and which depends on the heating of the furnace and the quality of the ores treated. When the ore contains a good deal of iron, of lime, or of lead, this accident occurs the oftener.

The restopped retorts lose the zinc at the restopped places. This is easily understood, for the moist clay, suddenly submitted to a high temperature, suffers a too sudden contraction, leaving fissures which allow the passage of the volatile metal, until they are stopped by the fusion of the exterior crust of the clay.

But the loss of zinc which occurs in the new retorts is more difficult to explain; and it is to this subject that I have specially directed my attention.

The Porosity of Retorts—It has been long known that retorts have the property of absorbing the zinc, as we may easily assure ourselves by examining a worn out one, the mass of which is impregnated with

the metal, colouring it black. It has been supposed that the substance of the retort has a certain property of absorption, by which it takes up the zinc up to a species of saturation, and that the retort is not in good working condition until this point of saturation has been arrived at. I did not deem this explanation satisfactory; and I first sought to ascertain if the zinc occurred in the substance of the retort in the state of combination, or as metallic zinc. To this end I ground up a retort, in the composition of which there was no coke; and I charged a new retort with this. I collected the zinc vapour in the condenser attached to this retort, and this, in an oxidising atmosphere, was immediately converted into white oxide of zinc. After the operation the residues did not contain a trace of zinc, and the ground-up mass of the old retort had again become white. This experiment convinced me that the zinc occurred in the mass of the retort in a metallic state.

Admitting this absorption of the zinc by the retort, I then asked myself how it occurred that such a volatile metal was not driven out of the retort by the high temperature existing in the furnace; and I soon recognised that a glaze was formed about the retort that prevented the free escape of the metal. But then before this glaze was formed there must have been an escape of zinc through the pores of the retort: and this very natural conclusion may easily be verified by an attentive examination of the remains of the retorts. These are the observed facts: the retorts that have remained but a short time in the furnace have no exterior surface glaze, and present a completely white mass; while those that have been more used are glazed exteriorly and show a black coloration, following an exterior ring contiguous to the glaze; and lastly, the still older retorts show an interior and exterior glaze and a completely black mass. Between these different varieties we see many intermediate stages. Thus we remark that retorts that are non-glazed in certain points, presenting certain glazed portions at the exterior, and others glazed portions at the exterior and interior. In these cases we find that where there is no glaze the mass of the retort is white; that where an exterior glaze only exists a portion contiguous to this glaze is black; and lastly that a glaze both on the interior and exterior has a corresponding completely black mass.

How the Zinc escapes through the Retorts.—It is evident from the observations we have quoted that the theory of the absorption of the zinc by the retorts must be rejected, since the black coloration of the mass does not commence from the interior. It may be admitted that when we place a new retort in the furnace, during the first charges the zinc will filter through the pores, and escape, in a great degree, by the chimney; in which case but a small portion of the metal charged is collected, the loss being the greater in proportion to the want of skill in the furnace-man in charging a greater quantity of ore in those retorts showing the greatest capacity. This condition continues until the exterior glaze forms a sufficient resistance to prevent the escape of the metal. When this glaze is still but very thin it is perforated by an infinity of small holes, indications of the escape of a gas. But when the exterior glaze is once well formed, if we charge the retort at the moment when the reduction is in full

activity, there is at once a considerable escape of zinc. There is consequently a great pressure in the interior of the retort, and a great penetration of zinc into its mass, diminishing, however, as the reduction advances; so that there is ultimately an interior escape, or return, of the zinc which had penetrated the mass; and there only remains in the mass of the retort that portion of metal lying close against the exterior glaze, which has too great a thickness to traverse, and consequently meets with too great an obstacle to escape. If in the charge of the retort there are matters capable of making a slag with its mass, an interior glaze is formed; and the zinc, which had penetrated the mass of the retort at the commencement of the operation, before this slag was formed, cannot again escape—being as it were imprisoned between two barriers. As an instance of this forth-and-back movement of the zinc in the mass of the retort, I may mention the fact that, frequently in cleaning a rather old retort, before the reduction is terminated, we see shoots of oxide of zinc starting from its interior, after it has been perfectly cleaned.

Estimate of the Loss from the Porosity of the Retorts.—In order completely to assure myself of the escape of the zinc through the new retorts, and of the loss which results, I made a series of experiments with a new retort during several days; and I have several times renewed these. I shall state the results of one of these which shows perfectly that we are far from collecting all the zinc charged in a new retort, and that there exists a notable escape of the metal by volatilisation.

Charges.	Zinc charged.	Zinc contained in the different Products.					Total of Zinc product.
		Metallic Zinc.	Zinc contained in the Fume.	Zinc contained in the Crusts.	Zinc adhering to the Tube.	Zinc contained in the Residues.	
	Kil.	Kil.	Kil.	Kil.	Kil	Kil.	Kil.
1st charge ..	5·07	0·7	0·656	0·57	0·143	0·77	2·839
2nd „ ..	5·07	1·6	0·984	0·855	0·214	0·286	3·937
3rd „ ..	5·07	1·6	0·574	0·380	0·113	0·603	3·300
4th „ ..	5·07	2·2	0·82	0·285	0·143	0·252	3·700
5th „ ..	5·07	2·8	0·738	0·665	0·071	0·568	4·842
6th „ ..	5·07	3·1	0·738	0·760	0·071	0·335	5·04
7th „ ..	5·07	2·8	0·738	0·475	0·143	0·532	4·688
8th „ ..	5·07	3·1	0·656	0·75	0·071	0·396	4·973
Total ..	40·56	17·9	5·904	4·74	0·999	3·742	33·285
Zinc contained in the mass of the retort, by analysis							2·000
Total Zinc in the products							35·285

In examining these figures we see that the loss of zinc principally occurred during the four first charges, or the two first days, that is to say it was only the third day that the retort became glazed. In the other experiments I made, I arrived at analogous results, less striking, however, than those given above; which is attributable to the fact that all the retorts did not act so badly as that with which I

operated—a result which depends greatly on the compactness of the mass of the retort. From a mean of several experiments I have ascertained that the loss from the porosity of the retorts may be estimated at 2 kil. per retort, or at about 2 kil. per 100 kil. of zinc produced.

Means of Remedying this Loss of Zinc.—I had now to consider a means of remedying the inconveniences arising from the porosity of the retorts. The first solution that presented itself was to hasten the formation of the glaze which opposes the escape of the zinc. I was thus led to apply to the surface of the retorts the same material that is employed for glazing in potteries—that is to say sea-salt.* It might be supposed that in applying this to the interior of retorts, we might be able to prevent at once the loss of the zinc which remains in its mass, as well as that which escapes through the retort; but there is no reason why this vitrifier should combine with the mass of the retort, rather than with the earthy matters introduced into it with the charge; on the contrary these matters in the interior of the retort have a greater tendency to form a slag with a strange substance, than has the refractory mass of the retort itself. I assured myself of the truth of this fact experimentally; I ascertained that the zinc penetrated thoroughly into the mass of the retort, notwithstanding the interior glaze—the only effect produced by this being, that the mass of the retort became black sooner than usual, in consequence of this vitrification preventing the return of the zinc. I have consequently confined myself to applying the glaze to the exterior.

Total charge of Zinc placed in the Furnace, by Analysis.	Glazed Retorts.			Ordinary Retorts.		
	Metallic Zinc obtained.	Zinc contained in the Crusts.	Zinc contained in the Fume.	Metallic Zinc obtained.	Zinc contained in the Crusts.	Zinc contained in the Fume.
443	87	43	5	43	47	5
445	115	62	6	89	59	6
564	152	57	7	137	56	8
702	186	63	9	171	58	9
694	199	76	7	183	62	10
702	197	60	10	187	60	13
719	232	74	13	217	70	14
701	208	66	7	205	48	7
725	226	82	13	226	74	13
Total ..	2,262 kil.			2,082 kil.		

The workmen at once recognised that there was a great difference between the yield of the retorts thus prepared and the ordinary retorts. In order to assure myself completely of this fact, I made a trial on a large scale, in a newly constructed furnace. In one-half

* Dr. Percy, in his *Metallurgy*, refers to the probable vitrifying action of Salt on the Zinc Pots, where, as is the common English practice, their external surface is coated with river mud: "this mud is taken from a river in which the tide rises high, so that it doubtless contains salt, which would tend to vitrify the surface of the pot."—Compare *Metallurgy*, p. 556. ED. M. & S. M.

of this furnace I placed ordinary retorts and in the other half the glazed retorts—taking care that both kinds of retorts were placed in similar conditions, so that the difference in the results could not be attributed to any difference in the heating. The trial continued during nine consecutive charges, and I took care to charge exactly the same quantity of ore to both kinds of retorts.

The difference is thus 180 kil. in favour of the side where the glazed retorts were placed. If we examine the production of the fume, we see that it is generally greater on the side of the ordinary retorts; which indicates that the temperature was higher on that side, since we know that a considerable production of fume is an indication of good heating. Consequently the amount of zinc obtained beyond the average by the glazed retorts cannot be attributed to a more perfect reduction. From the preceding table, we see that as the retorts become more used in the furnace an equilibrium tends to establish itself between the production of the two sides; which is easily explained by the consideration that the ordinary retorts become glazed in course of time. If we consider the yield of the furnace during these trials we see that it was bad during the first days, even on the side of the glazed retorts; which was due to the fact that the furnace was not sufficiently heated to completely reduce the charges introduced, so that a considerable quantity of zinc was lost in the residues. If we wish to estimate the yield that may be obtained when there is no loss of zinc either by corroded retorts or new retorts, we have only to consider the operation of the last day, where it is seen that the loss was 16·22 kil. per 100 kil. of zinc produced. I shall give another instance of a trial of the same nature made in the works of Corphalie, where the furnaces are smaller, only containing forty-two retorts instead of sixty, and where they treat calcined blende instead of calcined calamine. In these works, in order to place the ordinary retorts in exactly similar conditions with the glazed retorts, I arranged in a new furnace both kinds at random—the charge in each being equal.

Total charge of Zinc placed in the Furnace, by Analysis.	Results obtained.					
	Glazed Retorts.			Ordinary Retorts.		
	Metallic Zinc.	Fume.	Crusts.	Metallic Zinc.	Fume.	Crusts.
Kil.	Kil.	Kil.	Kil.	Kil.	Kil.	Kil.
108	9·75	0·50	20	8·25	1·50	20
252	65·00	7·50	51	48·25	10·00	44
424	110·00	8·00	40	102·00	8·00	40
	Another trial made in another New Furnace.					
90	9·00	1·50	23	7·50	1·05	23
180	38·75	3·00	29	26·00	4·00	29
275	49·75	5·00	41	43·75	6·00	45
330	68·00	10·00	35	69·00	8·00	32

The same law may be again observed here—that the glazed retorts yield more zinc during the first days, and that there is a tendency towards an equilibrium as the retorts become more used.

Practical Means of Glazing the Retorts.—After having recognized the advantage of glazing the retorts, I sought the means of applying it on a large scale, and the following is the mode of operation: a solution of sea salt is made—as concentrated as possible—with which is mixed sufficient gum-arabic to render the fluid a little viscous; after which the solution is heated and applied in several coats by a brush to the retort, dried and ready for annealing. To facilitate the labour, instead of an ordinary brush, a demi-cylindrical brush in the form of the retort may be used. After filling this brush with the liquid, it is only necessary to turn the retort 180° in this mould to give it a coat. The retorts thus prepared become rapidly glazed in the lower rows of the furnace; it is possible that this glaze is not sufficiently fusible for the upper rows, for which other matters may be tried; only it is necessary to guard against the employment of too fusible a glaze, which would melt in the annealing kilns, and cause the glaze to crack on the retort, being brought from the kiln to the furnace. The cost of a retort glazed by this process is about 5 centimes (½*d.*) more than that of the ordinary retort; and as, from the results I have given, it will be seen that we gain on an average 2 kil. of zinc each, by using glazed instead of ordinary retorts, there is thus a profit of about 1 franc (10*d.*) on an expenditure of 5 centimes (½*d.*). This method is also applicable to the Silesian process.

To sum up, by the glazing of the retorts or muffles used in the making of zinc, we gain:—

1. An increased yield of metallic zinc;
2. An advantage by causing less injury in the neighbourhood of zinc works, since the extra metal obtained by this method would otherwise be volatilised and escape in the atmosphere.

Dip and Underlie.

THE "dip" of a bed is, as every one knows, its inclination downwards, measured by the angle between the plane of the bed and the plane of the horizon. The normal position of a bed is horizontal, so that the measurement of its "dip," or deviation from this normal position, is naturally and necessarily made from the plane of the horizon.

In metallic mining, however, another term, conveying a different idea, is commonly used in practice—and the inclination of a bed or vein is spoken of as its "underlie." This is a well-known, and commonly used term; but nevertheless its true meaning—the one in which it has been invariably employed—seems to have been misunderstood by geological writers, who use it as a synonyme for "dip." Even so thoroughly practical a geologist as Mr. Beete Jukes defines "underlie" as the "inclination or dip of a vein or fault;" and it is not unusual for geological writers to say that a vein underlies at such and such an angle from the horizon.

But the real meaning of the word "underlie," as applied by miners to a vein or lode, is just the converse of this—for it is employed to express its deviation from a *vertical* plane. The normal position of veins—conversely to that of beds—is vertical; and consequently it is natural to measure their deviation from a vertical plane. Speaking of a vein, a miner will say that it has very little "underlie" if it is nearly vertical, and that it "underlies" very much if it deviates considerably from a vertical plane. And this is not only the sense in which it is at present universally used in practice, but it is also the sense in which it has ever been used and even in books until very recently. In Pryce's *Mineralogia Cornubiensis*, "underlie" is defined as "the deflection, or deviation of the Fissure from its perpendicular line;" and in Thomas's "Report," it is also calculated as "the angle of inclination from the perpendicular."

Therefore to say that a vein or lode "underlies" so many degrees from the horizon, is to state a contradiction in terms;—that is the "dip" of the vein, but not its "underlie." In fact the "underlie" is the *complement* of the "dip," and *vice versa*.

It may be considered that a distinction of this kind is unimportant, but such is far from being the case. In Cornwall, and in the numerous districts where the cornish nomenclature has been adopted, the inclination of a lode is expressed by the length of base corresponding to *one fathom* in perpendicular depth, considering the line of inclination as the hypothenuse. Thus one lode (A) "underlying" 14° (or "dipping" 76°) is said to "underlie" 1′ 6″; and another (B) "underlying" (or "dipping") 45°, is said to "underlie" 6′. Such a mode of expressing the inclination of veins is not only clumsy in itself, but it is incapable of that ready determination by which an angle can be at once measured by a clinometer; and it besides encourages a want of accuracy.

Yet with all these disadvantages, even this system is more convenient than that of expressing the inclination in degrees from the horizon—clashing as it does with all our conceptions of metallic veins, which naturally refer to, and express themselves in, the amount of deviation from the normal vertical position. Thus, in the cases given above, of lodes A and B, we involuntarily attribute the greater deviation to B; and consequently when we say that lode A only underlies 1′ 6″, while lode B underlies as much as 6′, the numerical expression of deviation is in the same sense as our natural conception of it. If, on the contrary, we say that lode A "dips" as much as 76°, while lode B only "dips" 45°, the numerical expression of the deviation is contrary to our conception of it. Hence, notwithstanding its clumsiness, it is more convenient in practice to express the inclination of a lode by the length of the base subtending the angle of the "underlie," than by the complement of this angle, or the angle of "dip"—particularly in comparing the inclinations of two or more lodes — inasmuch as the one conveys a direct numerical expression in accordance with our conceptions, while the other does not.

To those who may not be very familiar with metaliferous veins, it might seem equally easy that we should accustom ourselves to

regard their inclination with reference to the horizon as with reference to a vertical plane. This is really not the case. All our conceptions, and familiar modes of expression, assume the normal condition of a vein to be vertical, and we consequently involuntarily express its inclination as deviating so much from this stand point. But if it were otherwise, it would still be equally incorrect to use the expression "underlie" as synonymous with "dip." The former is a mining term, and if used at all must be used in the sense in which it has been ever employed by miners. It is of course open to those who prefer to express the inclination of a vein with reference to the horizon, to do so by giving its "dip," but then this must not be confounded with its "underlie."

To sum up therefore:—

As a simple matter of definition, the "underlie" of a vein must be considered as the complement of its "dip"—as the angle which the plane of the vein makes with a vertical plane following its strike or bearing; and, as a matter of practice, the inclination of metalliferous veins is most usually, and most conveniently expressed in this manner.

Notes on the Calamine Deposit at Silvermines in the County of Tipperary,

By George Darlington.

Within the last four years there has been found at Silvermines, in the county of Tipperary, a remarkable deposit of earthy carbonate of zinc. For some years the Mining, and the General Mining, Companies for Ireland, have successively carried on mining operations in this neighbourhood, chiefly with a view of obtaining lead and copper ores from the large Shallee fault, and the numerous remarkable open-cast-worked series of veins which at Shallee course almost at right angles with the general strike of the fault. Sometimes the mining operations have left a profit; but probably more usually a loss has been sustained. Nevertheless in the aggregate a large quantity of rich argentiferous galena has been sold, as well as a considerable quantity of copper, and some sulphur ore; while the mining results are shown in the form of a run of workings, extending for 3 miles in a general east and west line along the northern base and flank of the Silvermines mountain, a large hill attaining an elevation of from 1,270 to 1,620 feet at its various peaks, which rise somewhat precipitately from the generally flat land forming the plain extending from the Tipperary and Arra mountains, along the edge of Lough Derg and the Shannon, to Clare and Galway on the west and north, and terminating in the great central plain of Ireland on the north-east and east. Immediately to the southward, the district is bounded by the Keeper Hill (2,300 feet), and the mountain chain of Tipperary.

The stratification of the district is not without interest. The Silvermines mountain is composed of Silurian rocks, capped in places by the Old Red Sandstone, and flanked at its base by other Devonian outliers, which dip immediately under the Mountain Limestone, with which latter (in its lower strata) are associated beds of black Magnesian Limestone. The thickness of the Silurian series is unascertained; but the Devonian beds (a light red sandstone) are very thin, and with the exception of the patch south of Shallee mines these outliers are very inconsiderable in size, and mainly follow the line of the outcrop of the Shallee fault.

At Shallee, the curious series of north and south veins which I have already noted occurs. This point is 3 miles west of the calamine deposit; and I am informed that upwards of one hundred of these small veins have been wrought, all of them open-cast, and none of them to a greater depth than 7 fathoms. In some cases they are so close together that the "country" left standing between them has no greater thickness than 3 feet. They occur mostly in divergent bunches, and are usually in the vicinity of the Shallee fault; but, strangely enough, do not seem to run into it, cross it, or be in any way connected with it. Their appearance is quite exceptional, but they cannot be said to belong to the stockwerk family; I believe they are always found to the south of the fault, in the Devonian sandstone.

The Shallee fault is traceable for several miles, but its throw is variable, and not always easily estimated. Its valuable mineral contents are lead ore (argentiferous), copper ores (chiefly pyritous), blende, calamine, and sulphur. This arrangement of enumeration is the same as the progressive occurrence of the various ores, as the fault is followed eastwards on its stroke from Shallee to Silvermines. The blende mostly occurs scattered through the pyritous rock in inconsiderable quantities, while the occurrence of the calamine is still less frequent. The width of the mineral matter filling this fault varies from a few feet to several fathoms. At a little to the north of the fault, at Silvermines, a series of "old men's" workings have at some previous period been carried on, and report states that a good deal of argentiferous galena was extracted; be this as it may, the slags found in heaps at this spot attest to the carrying on of smelting operations. The mining works were scattered over an area of several acres, and the whole surface of the ground for that area is found covered with ochrey-matter and stones of calamine; this mass being in some places a foot deep. It is worthy of note, that a valuable mineral, so extremely wide-spread and apparent, should have escaped observation for so many years; however, about 1859, samples were sent to Professor Apjohn in Dublin, when the mineral was determined to be an earthy carbonate of zinc, and explorations were at once instituted. The result of these have shown a most extensive bed of zinc ore, varying from 10 to 60 feet thick, and covering a known area of several acres. It seems to occur as an interfoliation between the true limestone beds and the dolomite, while it dips north with the strata at an angle of from 20° to 30°.

This deposit is very analogous to many of those found in Silesia and Belgium. It yields an ore precisely similar to the better class

of ores from the first named locality—an ore which averages about 30 per cent. of metallic zinc when freed from its accompanying ochre. The remaining constituents of this ore are oxide of iron, frequently amounting to 30 per cent.; carbonates of lime and magnesia; with a little manganese, silica, alumina, and water: traces of cadmium are also reported as occurring. In the process of calcination, it is enriched on an average to about 40 per cent. of metallic zinc, and in the reduction furnace it parts with about half its zinc at a low temperature; the rest requiring a considerably higher degree of heat when the large amount of basic materials present come into most destructive action against the silica of the retorts. Hence the ore cannot be regarded as a valuable one; but this fault is partly balanced by its extensive occurrence. The quantity of ore at present raised is about 250 tons a month averaging 42 per cent. when calcined, and a further quantity of 300 tons averaging 16 per cent. when raw; the latter is allowed to go to waste at present, no economical application having yet been made of it. Besides this, there is a large quantity of fine ochre of excellent quality for making English Red, resulting from the settling ponds into which the water from the dressing house flows preparatory to its running into the little river at Silvermines. No valuable use has yet been made of this ochre.

The exact extent of the deposit is at present unascertained, but probably 100,000 tons of marketable ores have been laid open. The deposit is bounded on the south by the fault; east and west, it dies out against limestone boulders (not beds); and it may be about 150 yards in extreme width. On its dip down to the north it has been followed a very considerable distance, but seems to be tailing out into strings of from 1 to 10 yards wide, and of about the same thickness. Near its southern limit, the deposit comes to within 30 feet of the surface; but it rapidly deepens, and at the point where the main workings now are, may have an average cover of say 12 fathoms. It lies extremely loosely arranged, and is honeycombed with the workings of the "old men," who seem to have sought for lead ore which occasionally occurs scattered through the calamine. Besides this mineral, there is found some silicate of zinc, a little iron pyrites, blende, and sulphate of baryta. The ground is easily extracted, and the workings have a strong tendency to close rapidly and crush up.

The transit to market of this ore is one of the greatest drawbacks to its profitable employment. It lies fully 9 miles from the nearest railway station—Birdhill on the Limerick and Killaloe line;—while if sent *viâ* Killaloe and canal to Dublin, it has to go an equally circuitous and costly route before reaching the port of shipment to the smelter.

It may be asked—Is this the only similar deposit in the district? It certainly is the only one of its kind yet discovered in the United Kingdom, but I believe there is another if not a third of the same kind in the immediate vicinity of the present worked bed. Westward, about three-quarters of a mile, there is an outcrop of gossan and ochre, with stones of calamine scattered through it; and several tons of marketable ores have been raised from this spot. The appearance of this *outcrop* is almost identical with that presented by

the one working when first opened upon, and I have but little doubt that the explorations now commenced will prove the existence of another such bed of calamine (but perhaps more siliceous) as that now wrought.

Abstracts and Reviews.

NOTE ON THE MANUFACTURE OF HEMATITE PIG-IRON IN NORTH LANCASHIRE AND CUMBERLAND.

By M. S. Jordan.

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(Abstracted from the *Revue Universelle.*)

(*Continued from page* 157.)

Hot Air Apparatus.—The existing hot air apparatus, adapted for six furnaces in blast, are fourteen in number, that is two for each furnace, and two supplementary ones (which correspond to furnaces 1 and 5). These blast-stoves are of two different types. Those of the first type were constructed for the four first furnaces; but the arrangement has been changed in the two most recent ones, and those connected with furnace No. 1 have been lately rearranged—while the furnace was out of blast—in conformity with the system last adopted.

The first type, which appears to have been gradually abandoned, differed little from the known apparatus founded on the Calder system (Clarence Iron-Works, Gartsherrie Iron-Works). Although one of the grave inconveniences of this system had been partly remedied—that of its complication—it still in some degree remains, as will be seen by the following description and Fig 7, Plate II.* Each stove has exteriorly the form of an elliptical or oblong vertical cylinder of from 13′ to 17′ in length, 10′ in width and the same in height. The blast arrives by four inlet pipes, situated at the bottom of the apparatus, circulates in four courses, and escapes by two closely-adjoining outlet pipes at the top of the apparatus, and in a perpendicular plane to those by which it enters.

The principal parts of the apparatus (of cast-iron) are two demi-elliptical (horse-shoe shaped) horizontal pipes of curved rectangular sections, at the ends of which are the tubes, shown by the horizontal section in Fig 7. This horizontal pipe, which occupies half the area of the stove, is divided lengthwise by a stop-plate—another of which divides the pipe transversely into four compartments. On the upper flat surface of this horizontal pipe are two series of corresponding vertical sockets, into which are fitted the vertical blast syphon-pipes, which are six or eight in number on each side. These syphons, which are in the form of an S, are cast in one piece, and are about 6″ in diameter. The sockets on the horse-shoe shaped horizontal pipe are cast slightly conical, so that the weight of the vertical pipes tends to tighten the joints.

An arrangement in the interior of the furnaces serves to guide the gases—which enter at the top and escape at the bottom—into contact with the range of syphon pipes. The exterior walls are maintained in position by horizontal binders of wire rope.

The two advantages claimed by the partisans of this system are: the

* See last number of *Mining and Smelting Magazine.*

employment of semicircular horizontal pipes, by which the expansive movements may occur without deranging any of the joints; and the adoption of a central arrangement which increases and regulates the temperature of the apparatus. The heating surface of each stove is about 860 square feet, and the apparatus is arranged to heat to 425° Cent. (800° Fahr.) the blast necessary for three twyers. However, notwithstanding the improvement of certain details, these stoves, which are after all only a modification of the Calder system, have not afforded the desired results, since a different system has been adopted in those newly erected; and, as we shall see, the objection made to the system described is the unequal distribution of the blast among the different heating pipes.

In the new system the blast is also divided into four courses, but here it is obliged in each of the courses to pass through the entire extent of the vertical syphon-pipes. The apparatus besides is composed of but three pieces of casting, which are repeated a great number of times. The heating or vertical syphon-pipes, cast in one piece, are formed of two straight tubes of from 10″ to 12″ interior diameter, connected at the top by a communication pipe, and towards the bottom by a simple piece of solid casting. They are of two different heights; one set being the whole height of the apparatus, and the other only half the height. The bottom horizontal pipe is an oval casting, which has widening sockets cast on its upper face to receive the legs of the vertical syphon pipes. Each apparatus is composed of six ranges—that is, four entire pipes and two half pipes; in each range there are six syphon-pipes.

The heating surface of each of these stoves may be approximately estimated at 1,506 square feet, and as there are two stoves to each furnace it follows that the heating surface is about 15 square feet per square foot of blast consumed per minute; for as we shall see further on, each furnace consumes per minute as much as 7,000 cubic feet of blast, of a temperature of 700° Fahr.

In these apparatus the blast can be heated to 800° Fahr., if the temperature is forced. They are not liable to interior escapes of blast, which deteriorate so rapidly the cast-iron pipes; their construction is simple, their heating surface is considerable;—which are necessary conditions in gaining these high temperatures by the utilisation of the gases. Besides, their practical working is entirely satisfactory.

It is unnecessary to add that all the stoves are furnished with safety blast-valves, and that in order to avoid explosions a few cinders are always kept lighted on the fire-grate.

Gas Exhausters.—We have now to describe an apparatus which is entirely peculiar to the Ulverstone Works, and which no other establishment, we believe, in England or on the Continent has yet applied.

The blast-furnaces, as we have stated, are situated close to the shore, in a position exposed to the sea winds, which sometimes interfere with the draught of the chimney. It was determined, however, that the employment of the waste gases should be made with the greatest regularity, so as to consume the least coal possible, either for the production of the steam or the heating of the blast. To effect, this Mr. Smith conceived the idea of employing exhausters, more or less analogous to the ventilators of mines, or the exhausters in gas-works. They are, in fact, ventilators which draw the gaseous products of combustion by a large underground flue, and force them out into the chimeys by another underground flue.

The works will include four exhausters, situated in the open air, besides a building for their motive-engines. These exhausters are 10½′ in exterior diameter, and 13″ in interior diameter. They are worked by two engines, of 40 H. P. each, with 24″ cylinders and 4′ stroke, which transmit their movement by 16′ and 18′ cog-wheels.

We have not seen these exhausters at work as they were stopped at the period of our visit, but we ascertained that the gases circulated through them. We were told that the service rendered by these apparatus was very satisfactory, in connection with the system adopted of collecting the gases. We satisfied ourselves, besides, that no coal was consumed on the fire-grates of the numerous apparatus heated by the gases.

Charging Apparatus.—We have already stated that all the furnaces were furnished at the throat with spacious platforms all communicating together. Two inclined planes (situated between the furnaces 2 and 3, 4 and 5) serve to raise the charges to the level of these platforms: each of these inclined planes is formed of two strong wrought-iron girders, with an intermediate support, as shown in Fig 6, Plate II.

Each of these planes is traversed by a platform-carriage, the top of which is horizontal and which runs on four wheels. At the bottom of the plane there is an excavation, by means of which this platform-carriage is brought on a level with the ground, and at the head of the plane it fits into a space left in the platforms connecting the furnace; so that the barrows containing the prepared charge, can be wheeled on and off to it at a level. Each charge of ore consists of six barrows, and each charge of coke of twelve barrows.

The wire rope used on this plane passes over a pully, situated at the top of the platform, and winds round the engine drum; another carriage attached to a separate rope is used as a counterpoise. The motive-engine, of the kind used for drawing in collieries, is situated behind the range of furnaces.

There are two inclined planes and consequently two identical motive-engines. There exists no other means of getting to the top of furnaces; but the service is excellently executed, although there are 4,000 tons of materials per week to be raised on each plane.

General Arrangements of the Works.—The seven blast-furnaces (a^1, a^2, a^3, Fig. 9), are ranged on the same north and south line, parallel to the Barrow Canal. The hot air stoves (b, b, b), are ranged behind the furnaces in the same line, between them and the canal, and act as supports to the large horizontal cylinders (already mentioned), which serve as general reservoirs to the blast and furnace gases. At the southern extremity of these cylinders is the building (c) containing the blast engines. Between the hot air stoves and the sea are the steam engines (d, d), for the use of the inclined planes and the gas-exhausters (e).

The inclined planes (f, f) are shown passing into the charging yards (g), adjoining which are the various compartments (i, i) into which wagons arriving at (h, h) discharge the coke and ores. Although the works are situated about a mile from the Barrow Station, lines of rail are laid down in every direction, and there is a special locomotive for the use of the works. Everything is so well arranged that there are no delays or stoppages, although about 4,000 tons per twenty-four hours were brought in and out at the period of our visit.

The Working of the Ulverstone Furnaces.

The coke employed is, as we have said, the *Best Pease's coke*, coming from Darlington, in Durham. It is very fine and hard, only containing from 5 per cent to 6 per cent. of ashes. The ores, like the limestones, are brought from the neighbourhood of Barrow and Ulverstone, from distances ranging from four to five miles. The ores are raised from the various mines connected with the works. They are as follows:—

1. The *Red ore*, properly so called, coming from Park Mine, is a red hematite, with a lustrous fracture, entirely identical to the eye with the

ore of Lavoulte. Its produce is as high as 67·55 per cent. of iron, and it contains :—

Peroxide of iron	96·50
Silicious matters	3·0

2. The *Newton ore* (coming from Newton Heads mine) is a mamillated radiated hematite. Its produce is 67·02, and it contains :—

Peroxide of iron	95·75
Silicious matters	4

3. The *Best Mousell ore* (from the Mousell mine) is a pisolitic hematite. Its produce is 65·80 per cent., when it contains :—

Peroxide of iron	94·0
Silicious matters	5·50

4. The *Puddling ore*, coming from Whitbrigg's mine, is pulverulent. Its produce is also 65·80 per cent.

5. Lastly, the *Black ore*, coming from Park mine, is a highly manganiferous red hematite, which only contains 30·03 per cent. of iron, but yields on analysis :—

Peroxide of iron	42·90
Protoxide of manganese	50·00
Silicious matters	7·10

These ores are employed mixed in certain proportions, of which the following is a summary analysis, showing a normal produce of 57 per cent. of iron :—

Peroxide of iron	81·44
Gangues	12·50
Water	6

We should add that the ores which compose the charge are generally in small pieces, mixed with the fine dust resulting from the friable and pulverulent nature of some of the hematites. They are fairly fusible, and easily reductible.

We shall proceed to give a few details on the working of furnaces, Nos. 5 and 6, which are the newest and most interesting. Indeed it is probable that gradually the four other furnaces will be brought into the same condition as that of Nos. 5 and 6.

The blowing in of the furnace presents no peculiarity. A quantity of dry wood is placed in the hearth, the rest of which, and a small portion of the boshes, is filled to the height of upwards of 6′ with large coal, arranged so as to allow of the passage of a small quantity of air : above this the furnace is filled with coke up to the throat, where there is the first charge of limestone with a little ore.

The blast is introduced into the furnace by six twyers, the nozzles of which are 3″ in diameter ; its pressure is about 5″ of Mercury, and its temperature 700° Fahr. As to the quantity of blast used, it is estimated at about 7,000 cubic feet per minute, indeed the engine No. 2 works at the rate of 14, and No. 3 at the rate of 17 double strokes per minute, blowing five furnaces, representing 27 nozzles, so that the total volume engendered is 32,000 cubic feet, or 1,150 cubic feet per twyer, or 7,000 cubic feet for a furnace blown by six twyers.

The production of furnace No. 6, during a course of working under our own observation, was about 90 tons of grey pig-metal (No. 2 and No. 3) per 24 hours. The exact average of the first fortnight (14 days) of April, 1862, was 91 tons, 7 cwts., 3 lbs. per 24 hours. The furnaces Nos. 1, 2, 3,

and 4, produce less metal than furnaces Nos. 5 and 6, on account of their less dimensions and the smaller amount of blast used, but the average of the works exceeds 60 tons per furnace per day.

These results leave very far behind those of the largest furnaces known up to the present time. Even those of the immense furnace of Dowlais, which is more than 20′ in diameter at the belly, and is blown by 7 twyers. We shall also see presently that they are obtained under most favourable conditions as regards price.

Three castings are made per twenty-four hours. The cinder, working for grey pig (Nos. 2 and 3), is opaque, of a greyish-white colour, with a very slight violet tint. Its quantity is small, considering the richness of the bed of fusion, and it contains very little iron. The furnaces are almost always worked for grey pig-metal, although in this respect their conditions are the converse of those of the Welsh works, since the coke is relatively dearer than the ores. The speciality of the iron for the making of steel is, however, far more important than any question of economy of fuel.

The following is the consumption of materials per ton of grey pig-metal (Nos. 2 and 3):—

	Tons	Cwts.		Tons	Cwts.
Ore	1	14	to	1	14½
Coke	0	18	„	0	18½
Limestone	0	5¾		—	

From the information we have received the cost-price may be approximately taken as follows;—

	£	s.	d.
Ore	0	18	10
Coke	0	17	4
Limestone	0	0	9
Coal-slack (for boilers and hot air)	0	1	1
Total labour	0	6	0
Sundries (materials, repairs, management)	0	4	0
Total cost-price per ton of pig-metal, exclusive of interest of capital	£2	8	0

These figures, which we consider very near the truth, and certainly rather above than below, closely approximate the cost-prices of the Cleveland pig-iron, made with the same coke, and with a mixture of the ores of the district and the hematites of the Lake country. The Cleveland works are more favoured in respect of coke, which only costs them about 10s. per ton; but the ores—even those of the district—are dearer, if even they cost little more than 6s. per ton calcined, as they only yield 40 per cent. of pig-metal, and consume about 1½ ton of coke.

Thus in economical production the Lake district takes its place immediately beside that of Cleveland, and surpasses Wales and Staffordshire in respect of the quality of its products. Such a result has created a lively sensation in England, showing that the richness of the ores has more than counterbalanced the inferiority of Barrow in its situation with regard to fuel. For ourselves, we believe that the example of Messrs. Schneider and Hannay will find imitators, not only in the Lake district, but perhaps also in other parts of England; where, to the natural advantages derived from a close proximity to the raw materials, will add those derivable from carrying to as high perfection as possible the apparatus and the modes of manufacture.

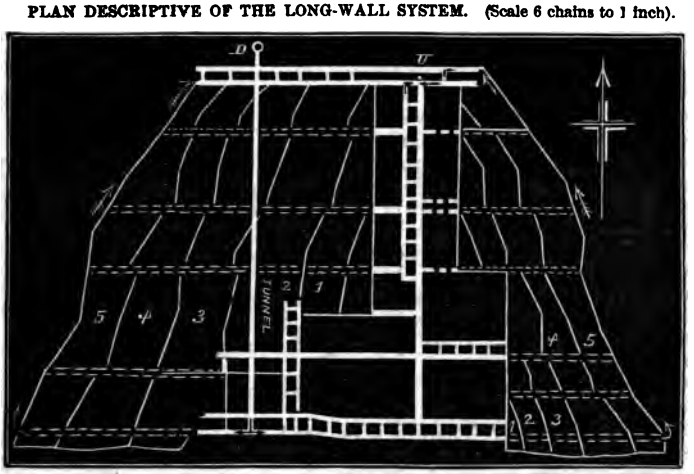
LONG WALL *versus* PILLAR-AND-STALL SYSTEM OF GETTING COALS.

(*Continued from page* 105.)

With the long-wall system the case is very different; for owing to the difficulty and expense of keeping good the wagon and air-roads, the distance is practically limited in many mines to a few hundred yards. The greatest distance on the line of level that I have known to be worked out upon the long-wall system is rather more than eight hundred yards; and in this case it was very expensive to keep the wagon roads so that the coal could be brought along them, owing to the constant creep of the floor, and the wagon road rails having to be repeatedly taken up and lowered. In some instances the difficulty of keeping the main wagon roads in order is increased from want of skill. I have a case at point where it was very difficult indeed to maintain a wagon road, although it was little more than a hundred yards in length; and at that point it became a question for serious consideration whether to abandon the workings or continue them upon some different principle. It was, however, ultimately arranged to try a few yards farther upon the long-wall system; but instead of only working out four yards below the bottom wagon road, to work out fifteen: after this slight change it became practicable to carry the workings between five and six hundred yards farther without experiencing more than ordinary difficulty in keeping the wagon roads good. Where there are numerous faults it is difficult to work a mine to advantage upon the pillar-and-stall system, but it is still more difficult upon the long-wall.

FIG. 16.

PLAN DESCRIPTIVE OF THE LONG-WALL SYSTEM. (Scale 6 chains to 1 inch).



D. Downcast. U. Upcast. Each pair of figures (1, 1; 2, 2; &c.) represents the area worked out every six months.

The pillar-and-stall system can be used under some circumstances where it would almost be impossible to work upon the long-wall. For instance, in a mine with which I am acquainted, of from six to seven feet in thickness, where the stratum immediately overlying it is a strong sandstone rock, 23 yards in thickness. The difficulty of obtaining material to build packings or walls with in such a mine, and the slender chance any walling

would have in resisting the superincumbent weight when the rock began to weight, will show the difficulty of working such mine upon the long wall system. There are other cases where it would be equally difficult: I know of at least a dozen mines that I should most unwillingly undertake to work upon such a system were I required to do so. It has been urged as an objection against the long-wall system that the subsidence of the surface is greater than in the pillar-and-stall system. I contend that the reverse is the case, and that the subsidence is less, owing to the packing of the roof with strong walls, and that it takes place far more regularly and less violently than with the pillar-and-stall system, unless it so happens that a far greater proportion of coal has been left unwrought in working the latter system than ought to have been.

The quantity of timber used is not materially different in either system. Indeed the cost of getting depends so much upon circumstances that it is unsafe to hazard an opinion, unless both systems have been employed in the same mine, under very similar circumstances; and, even then I have sometimes found the results in favour of the pillar-and stall system, and at others *vice versa*. Both systems possess their advantages; and that it is unwise to confine ourselves exclusively to any one system. It may be that occasionally some other system will answer better than either of these systems, for we by no means embrace the whole of the systems of getting coal when we speak of the pillar-and-stall and long-wall; although many of the methods of working coal are but modifications of either one or the other of them.

The following discussion ensued on the invitation of the President:—

Mr. Thomas Knowles—May I ask how you arrived at your conclusion that there was a loss of 5 per cent. in working the pillar-and-stall system? I have had something to do with the working of that system for some years; and I must confess that my opinion is that it is better under ordinary circumstances than the long-wall. I should very much like to know how you arrive at a loss of 5 per cent.

Mr. J. Goodwin—Well, I believe that is generally allowed in computing the average; but I may state that I myself have seen more than 10 per cent. lost with careful management.

Mr. T. Knowles—Probably you have. But why should it be so? Of course any quantity may be lost by imprudent management. But my question is—how does Mr. Goodwin arrive at the conclusion that there is a loss of 5 per cent. in working the pillar-and-stall system?

Mr. Goodwin—I arrive at the conclusion partly from experience and partly from data furnished by nearly all the mineral surveyors in the county. I am at this time acquainted with a mine which I defy any person to work at less than 10 per cent. loss on the pillar and stall system.

Mr. T. Knowles—But I am speaking of mining generally, and not of one mine in particular.

Mr. Goodwin—It is of mining in general that I speak when I mention 5 per cent.

Mr. T. Knowles—Mr. Goodwin says that his reason for supposing there is less breakage, or more percentage of round coal, in working the long-wall system, is because he works 10.000 tons on the pillar-and-stall system. Now, does he suppose that that is sufficient to give the system a fair trial as to whether he can get a fair percentage or not? I have an idea that the mere excavation of 10,000 tons is not sufficient.

Mr. Goodwin—I think it furnishes very excellent data to work upon. And this is by no means an exceptional case. I don't mean to say I confine myself to 10,000 tons, but I wish to speak of what I knew, and happening to have these honest facts in my possession, I thought it best to lay them as such before you. I could mention a mine where the percentage is from

25 to 28 in favour of the long-wall system, independent of the before-mentioned cases.

Mr. T. Knowles—There is a wonderful difference between excavating 10,000 tons of the solid coal, and working out 5,000 or 6,000 in wide work. Then you will find there is such a weight on the coal that it has a tendency to crush it, and you will get a different percentage.

Mr. Goodwin—In working we build a packing on each side of the wagon road, varying in width from six feet to three yards, as the nature of the work might require. We make a wagon road the same as on the pillar-and-stall system, and the only difference I have experienced in any of the mines I have yet tried is in the creep of the floor. I am not quite certain whether this difficulty could not be overcome by blowing down the roof.

M. T. Knowles—Do you mean to say that the packing keeps the whole of the roof?

Mr. Goodwin—Most certainly I do.

Mr. Fort—What is the area kept up by this packing?

Mr. Goodwin—Say 300 yards on line of level, and 150 yards on the rise and dip in the plan now before you. But I have known the workings to extend 1,400 yards from the two extreme points, with 150 yards of rank or width from the rise to the dip of the workings.

Mr. A. Knowles—How many walls are there in 100 yards in breadth and 200 yards in length?

Mr. Goodwin—The walls are built at various times, as the coal is worked out; and we keep the walls in the line of level, and take them with us. The roads are 20 yards apart, which I find to be the most convenient distance. We have occasionally packing between, if desirable.

Mr. A. Knowles—And will that amount to sufficient to support all the strata to the surface?

Mr. Goodwin—Yes, it does.

Mr. Farrimond—I think it is an impossibility.

Mr. Fort—What is the thickness of the strata?

Mr. Goodwin—250 yards. After you get a certain distance you do not experience any of the weight just now referred to.

Mr. T. Knowles—It is a new theory to blow the roof down in order to let the warren lift. It is a theory I do not understand. There is no practice in that kind of work.

Mr. Goodwin—When I advanced the theory, I simply stated that it was an opinion of my own, but whether it is feasible or not I cannot say. I shall try it.

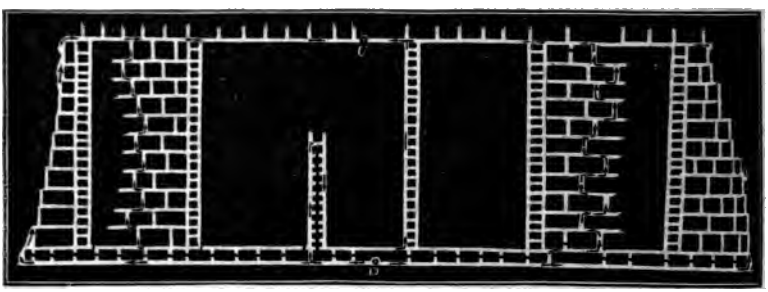
Mr. T. Knowles—Well, it is rather an expensive process.

Mr. Binney—I think we are much obliged to Mr. Goodwin for bringing a novelty before us, for evidently the long-wall working seems to be a novelty in Lancashire. I have no doubt there will be more advocates for the pillar-and-stall system in Lancashire than the long-wall. Nevertheless, I am glad to see that Mr. Goodwin does come forward and say something in favour of long-wall working. If the Lancashire gentlemen went into North Derbyshire probably they would find a great many advocates of the long-wall system, and they would see advantages there which they do not see in Lancashire. The same remark will apply to the East of Scotland. I have a great idea myself that the different systems of long-wall and pillar-and-stall workings will have advantages in particular districts. I think in Derbyshire, where the long-wall system has been going on for 150 or 200 years, the men are so thoroughly drilled to it, and work it so scientifically, that its results would be hardly fair as applied to us. You would doubtless be a very long time in Lancashire in getting your men to work as well at it as they do in Derbyshire. On the other hand, and on the same principle, you would have a difficulty in introducing the pillar-and-stall system into Derbyshire. In Scotland they all use the former, and they say they can

get a great deal more coal by it. I have a little colliery of my own there, and I am tied down by lease to work it upon the long-wall and no other system, although I would willingly have been allowed a choice. What I saw in Derbyshire, and what I see now, is that they certainly get cheaper and larger coal than in Lancashire. There may be peculiarities in the field, and in the nature of the roof, which give them some advantage; but I think it is not impossible that there may be many seams of coal in Lancashire which the long-wall would work with success.

Fig. 17.

PLAN DESCRIPTIVE OF THE PILLAR-AND-STALL SYSTEM. (Scale 6 chains to 1 inch).



D. Downcast. U. Upcast. The arrows show the air roads.

Mr. T. Knowles—I find from inquiries which I have made, and also from going into Derbyshire, that we get our coals cheaper than they do in that district. The Lancashire colliers in Derbyshire will not work the long-wall system. We get our coals in Lancashire, as a rule, considerably cheaper per ton than in Derbyshire, where they adopt the long-wall system.

Mr. Binney—I think the Derbyshire people would decidedly object to that statement.

Mr. T. Knowles—I think not, sir, for I have been told differently. At the same time I concur with you that there are mines in Lancashire that are worked upon the long-wall system with advantage, particularly the thin mines.

Mr. A. Knowles—Referring to ventilation, may I ask whether Mr. Goodwin ventilates the goaf?

Mr. Goodwin—No.

Mr. A. Knowles—And do you not apprehend danger from the gas?

Mr. Goodwin—Not the slightest.

Mr. T. Knowles—I have had the management of collieries for 15 years, during which time we have only had one fatal accident; and it has all been pillar and-stall work.

Mr. Binney—But in the neighbourhood of Wigan there have been a good many accidents. If you take the long-wall system in Derbyshire and Scotland you will find that they have never had such accidents as with the pillar-and-stall system generally.

Mr. P. Higson (Inspector of mines)—The best proof that can be given of the merits of the long-wall system is that there are several mines in Lancashire now worked on it with profit, which could not be worked at all with the pillar-and-stall system. There are also many others in Wales.

The President—It is evident that the preponderating feeling amongst the viewers of Lancashire, as far as they are represented by this meeting, is in favour of the pillar-and-stall system. I myself was brought up in the North of England, and I thought then there was nothing like the pillar-and-stall system. But during the last twenty-two years I have been con-

stantly more or less in districts where the long-wall system has been followed, and I find that the advantages of that system have grown upon me year after year; and it is now many years ago since I arrived at the conclusion that of the two the long-wall is incomparably the better. Although Mr. Thomas Knowles has carried on some mines at Wigan in the most successful manner, I do not think we should be led away from the advantages of the long-wall system because he is able to produce equally beneficial results by the other. In Lancashire the best methods may be said to be a combination of the two. Pillar-and-stall—so far as driving to the extremity of the boundary is concerned—and then bringing the coal back by long-wall, or semi-long-wall, and pillar-and-stall. There are places where the waste is not only more than 5 per cent., but I know of my own knowledge that there is actually in thick and tender seams in South Wales one-half of some of the best steam coal in this country being left in the ground, crushed, spoiled, and irrecoverably lost. That is by pillar-and-stall work, whilst in the same colliery I have taken comparative results of the coal got by the long-wall system, and I can state that almost the whole of the coal was obtained, and scarcely any lost. These points to which Mr. Goodwin has alluded may appear different to those who have not really gone practically into the subject of the long-wall, especially what was called his new theory of taking down the roof to make room for the wagon way to lift. There are many long-wall collieries where it is decidedly the better way not to cut the bottom at all. Cut down the roof until you have all your ground settled about you, and you will soon have as permanently settled a road as if it had been cut into the solid coal. I have seen this over and over again; and if you will go into some of the mines in Shropshire, where long-wall is universally practised, you will see what I mean. There is no other system practised there. In South Staffordshire there is scarcely any other system except in the 10 yard coal, which is worked to a great extent by pillar-and-stall, and in a most wasteful way. In some parts of Derbyshire, or in the Clayton colliery at Manchester, for instance, you will see long-wall carried out successfully; and it appears that at Clayton Mr. Goodwin has noticed the very same thing which I have noticed in other places. In Scotland, most of the ironstone and coal mines are conducted upon the long-wall system, and we all know that no men go more minutely into the matter of £ s. d. than Scotchmen. Mr. Binney tells you that there he is actually compelled to work his colliery long-wall work. I have myself seen thick seams in the South of France worked by the long-wall system. I have there seen a seam 80 feet thick worked in this way. It may be easier to work a thin mine long-wall work, but it is not impossible to work thick mines long work, and I believe quite as successfully as working them the other way. Mr. Goodwin's paper touches on many other points, all of which have a most important bearing. In the long-wall the ventilation is carried exactly where it is wanted, whereas in the pillar-and-stall you are dependent upon cut-throughs, bratticing, or other methods, all less certain. With regard to the question of safety, I have never seen any comparative results of the number of accidents as arising from the two systems, but I believe if they were compared together you would find that the result is considerably in favour of the long-wall. In Scotland the number of accidents is exceedingly small, as compared with our own accidents. In Derbyshire, accidents are few; in Shropshire few. In South Staffordshire they are more numerous, but that is because of the thick coal worked on the pillar-and-stall system. I believe, if you take the whole country round, you will find that the waste in pillar-and-stall working—that is, where the real pillar-and-stall, and not a combination of the two, is practised, as in Lancashire—is very great, that a larger proportion of small coal is produced, and that a large proportion of very valuable mineral is lost, of which sooner or later this country

will have to feel the ill effects. We are working very fast over some very valuable seams which are being rapidly removed. The best seams at shallow depths are fast going away. I believe that the long-wall system was introduced into the Manchester district by the late Mr. Bradbury, several years ago. He was conversant with both systems, and had mines in Staffordshire worked by the long-wall system. He saw the advantage of that system as compared with the other, and he introduced it here. I am glad to find that Mr. Goodwin has extended it into the Peacock mine.

Mr. P. Higson—I have seen the long-wall system carried out on a large scale almost to perfection. I have seen it carried out on a similar scale in the neighbourhood of Wigan, in the present day. In the yard coal, in the cannel, and in other thin seams, the system has been carried out quite successfully, while it failed elsewhere, although tried by the same people; from the fact that there was an overwhelming weight in the place, crushing the coal into small. With regard to the two systems, as shown on the plans, they are now carried out in two collieries in my district side by side. The quantity of small is equal in both, while that gives the larger outlet which provides more working places for the men.

Mr. T. Knowles—I still contend there is no occasion to lose 5 per cent. in any mine.

Mr. Farrimond—I have never seen 5 per cent. loss, and I have gone over a great many mines worked by the pillar-and-stall system. With regard to the small coal, it must be remembered that it often results from the use of the pick.

Mr. P. Higson—We must all admit that clean working is in favour of the long-wall system.

Mr. Goodwin—This is a subject upon which we cannot but have erroneous ideas if we have only made our observations in one locality. With regard to the workmen, I say they are safer with the long-wall system, because there is no breaking down of the works.

A desultory conversation then took place between Mr. Goodwin and Mr. Knowles.

The President—We have many mines in this county, for instance the Cannel about Blackrod, and also some thin seams, which are worked long-wall; whereas they were once worked on the pillar-and-stall system. All that narrow work is now saved; and only about a month ago one of the large coal owners of South Wales, who has some of the most extensive and the deepest steam coal mines in the Aberdare district, wished to introduce the long-wall system, so satisfied is he of the advantages it possesses over the old pillar-and-stall. But in South Wales they are not only proposing, but now in some cases are actually working on the long-wall system. Possibly the heading of this paper, "Long-Wall *versus* Pillar-and-Stall," has something to do with the antagonism set up against it. I do not see that there is any antagonism existing between the two systems. The long-wall system, is adapted to a great number of seams. Through the whole of Belgium to depth of 940 yards there is no other system followed. In that country the engineers, from the results of practice and consultation, have come to the conclusion that this is *the* system, and therefore they adopt it. And we also, are gradually introducing it into other countries, than those in which it has been used from time immemorial. I believe there is as little loss of coal generally in working the Lancashire coal mines, as there is to be met with in any district, but that is owing to the combination of these two systems.

Mr. Goodwin—I grant there is a deep-rooted prejudice against this system. I have experienced some of it myself in introducing it as I have into six different mines in different parts of the country.

M. MOISSENET ON THE CORNISH METHODS OF DRAWING STUFF.

De l'Extraction dans les Mines du Cornwall. Puits inclinés et coudés. Par M. L. Moissenet, Ingenieur des Mines. Paris: Dunod, Quai des Augustins, No. 49.

In his introduction, M. Moissenet points out that a careful attention to the details of drawing stuff, becomes the more important in proportion as the matters extracted are of less value, and as the depth from which they are extracted increases. In certain cases the power of drawing the stuff is the only limit to the production.

These conditions having weighed more heavily on collieries they have naturally made the greater efforts to overcome them; and both in England and on the Continent have succeeded in perfecting the methods of drawing so as satisfactorily to fulfil the requirements of rapidity and economy. Compared with collieries, metallic mines remain in a condition of relative inferiority.

Recently, however, many of the Cornish mines have found themselves subject to somewhat similar conditions. The ore broken is of an extremely low percentage, and has often to support a very heavy cost in mechanical manipulations; the depth, continually increasing, exceeds 250 fathoms; while the extent of the workings is such, that the quantity of stuff to be drawn yearly is from 30 to 40,000 tons, and even upwards. Consequently the attention of engineers is at present more than ever directed to the subject; but the problem, although so simple in appearance, is really surrounded with various difficulties.

The notion of applying the colliery system, *en bloc*, to metallic mines will not bear a moment's examination; for the means must vary with the conditions and above all must remain proportionate to the object to be accomplished. As, notwithstanding the steam-engine, there are still cases where the hand-tackle and the horse-whims must be used—so by the side of shafts possessing the most perfect mechanical appliances, there are others where chains and kibbles can still be more advantageously employed.

In this matter, more than in many others, it is important never to lose sight of the question of economy. In seeking to establish a technical perfection it must be pre-supposed that the end to be attained justifies all the expenses of the first cost; but in the present condition of mining in Cornwall the engineer meets with obstacles inherent in their very nature —obstacles ever varying—which he cannot remove, but which in each case he must deal with in the best manner possible. The chief of these obstacles results from the fact that the miner—ever directing his attention to the finding of the ore, and then to breaking it—arranged his workings primarily to suit these objects, and, consequently, often advisedly neglects any arrangement for ultimately facilitating the drawing of matters, the existence of which is still uncertain.

It is therefore out of the question to look for the establishment of any typical method — any absolute perfection; all we can do is to avail ourselves of the experience already acquired, so as to adopt in each given case the means that seem most suitable to it. M. Moissenet's object, however, is merely to give, in a systematic form, the result of his enquiries on the subject, derived from various sources, but particularly from personal investigation during a residence in the county. In pursuance of this object he divides his memoir into two parts:

The *first part* includes—

§1. Special conditions of drawing and the obstacles to its study;

§2. Descriptions of the various methods in use;

§3. Description and cost of the apparatus.

The *second part* includes—

§1. Particulars of cost, including the particulars of yearly cost at several mines;

§2. Consumption and effective power of the engines, labour in filling and landing;

§3. Comparison and discussion of the various methods described.

First Part.

§1. *Special Conditions of Drawing and the obstacles to its Study.*

Nature of the Ores.—The ore broken is of various sizes, ranging from large rocks to a small and even muddy state; and as the gangue is generally quartzose, the waggons, &c., employed in its transport or drawing must be of considerable strength, and consequently proportionably heavy.

Arrangement of the Shafts.—The shafts, generally opening to the back of the lode, are vertical to the point of intersection with it, and are then continued on its underlie, which is usually variable. Although sunk in a plane perpendicular to the bearing of the lode, the shaft often has several turns or elbows, and sometimes even its underlie changes altogether. Some mines, however, have shafts entirely vertical; and in others care is taken to preserve the same underlie as much as possible. Diagonal inclined planes on the lode are not much in use. There is no object in discussing the relative merits of inclined or vertical shafts; the first will always remain in great majority, and this is the principal fact we have to deal with in considering the question of drawing. All the shafts are rectangular, and timbered where the ground requires it. The inclination and the state of the walls are important elements, upon which, however, particularly the latter, it is not easy to obtain full information.

Numerous Underground Filling-places.—The levels, usually ten fathoms apart, have each their "plat." In deep mines, of course, there is scarcely anything to draw from the shallower levels; but the five or six deep levels are often simultaneously in working, and the drawing takes place alternately from each at variable periods. From this multiplication of underground filling-places - whose existence, besides, is precarious—it is evidently impossible to fit them up expensively.

Underground Tramming.—Each level serves as a gallery for the tramming of the ores, coming either from driving the end, or from the "passes" above. The size of the level is such as only to admit of one line, so that taking into consideration the time required in filling the waggons, the tramming cannot be carried on with very great activity, or the arrivals of the ore at the shafts be very regular. Hence the necessity of excavating at each filling place, a space where the ores may be accumulated previous to their being drawn.

One Engine for several Shafts.—The workings on different portions of the same lode, or on parallel lodes, are often without underground communication, or at least tramming from one to the other would be very costly, in which case the ores have to be extracted by several shafts near each other; under which circumstances economy suggests the employment of a common engine. Two shafts are sometimes worked in conjunction—that is to say, with one skip or kibble in each, but this arrangement has many inconveniences.

Intermittence.—It is only in large mines that the drawing is continuous in certain shafts, where the size of the lode and its continued richness in depth in the vicinity of the shaft, approach the conditions of drawing in collieries. According to the localities therefore, we find:—

I. A continuous drawing; in which the engine draws from one shaft

only—draws from two shafts worked in conjunction—or from several shafts alternately.

II. An intermittent drawing; in which the engine works so many hours out of the twenty-four, or so many days in the week.

The proportion of Stuff to be drawn.—If we institute a comparison between mines of equal *production*, we find great differences in the quantity of matters extracted, and the same holds good for mines in which an equal quantity of stuff is *broken*. This difference may be attributed to the following causes:—

1. The greater or less concentration of the useful mineral in the ore. Thus in the working of large, but poor, tin lodes, it is necessary to draw to surface almost all the ore broken, although some of it may be thrown aside after spalling and picking. In the "dredgy" ores of copper and lead the same is the case.

2. The extent and nature of the workings. When a mine contains extensive old workings, left from ground taken away and incompletely filled up, these are made use of, if they are accessible, as receptacles for the "deads" derived from existing workings. If in these conditions the ore is in rich veins, easily separable from the gangues and from the country, it is possible considerably to limit the amount of stuff drawn.

3. The mode followed in opening and breaking the ground. In some districts the productive part of the lode is first "dizzued," and is then taken down under the favourable conditions above referred to. Besides this we have to take into consideration various other matters too wide to enter upon here.

4. The narrow extent of the workings. When a new mine is opened, for several years it is indispensable to draw all the stuff broken. In the case of a recently commenced mine horse-whims are used, which, notwithstanding their disadvantages, are suitable to the intermittence of the work, and the multiplicity of points of trial: they may be used to a depth of 70 fathoms.

Obstacles to the study of Drawing.—From the preceding statements of the principal causes of variation in the conditions which affect the question of drawing, it will be seen that it cannot be studied without an examination of numerous mines, and even with full information of this kind it is also evident that it would be no easy matter to compare these data so as to deduce any general results. But the attainment of the information itself is no easy matter, for the following reasons:—

1. Accounts. The method of keeping accounts in Cornish mines is not such as to enable us readily to ascertain the cost of different operations. A stranger, even if a perfect master of the art of book-keeping, would assuredly seek in vain in the books of a mine for any information on the subject. Even the agents themselves are obliged to study the matter specially with a great deal of trouble, and even then many of their data are estimates.

2. Uncertainty as to the weight of the matters drawn. A knowledge of the weight of the matters drawn, which is so indispensable to ascertain the cost per ton, is rendered very uncertain by local usages and by a deplorable system of weights and measures. The only fact ascertained is the number of kibbles or skips drawn. In each mine it is *taken for granted* that one hundred such weighs so many tons, and although it may be supposed that this may be checked in tin mines by the measuring or weighing which precedes the stamping, and that consequently we may have some guarantee of its correctness, such is really not the case, for this weighing or measuring only takes place after the breaking and picking, and consequently after the waste is thrown aside;—so that this only affords us data as to the exact quantity that goes to stamps. With the old custom, still largely in use, of

measuring by the sack, it may really be said that weight is ignored, for the sack varies from 11, 12, 14 gallons and upwards, and yet everywhere the one hundred sacks is estimated to weight from 9 to 10 tons. In the case of tin, as in that of copper and lead, we therefore only know the number of kibbles or skips drawn; the weight of which naturally varies with the nature, condition, and proportion of the ores and associated gangues, and even with the forms of the skips or kibbles used. A frequently and constantly renewed system of weighing can alone furnish us with a knowledge of these variations, and this certainly has not been done if we may judge by the numerous discrepancies we meet with at various points in this respect.

Classification of the Cost.—The cost may be distributed into the following groups: —

At the shaft	Chains or ropes.	
	Kibbles or skips.	
	Maintenance and repairs.	
At the Engine	Coal.	
	Tallow, oil, hemp, packing.	
	Engine driving	Labour in drawing.
At Filling and Landing	Filling	Labour in drawing.
	Landing	Labour in drawing.

If we take a long period, a year for example, we may fairly approximate at these expenses, particularly where the drawing is continuous. Where it is intermittent, the costs at the engine are largely augmented, and there is a waste in the employment of the labour portion, inasmuch as the wages of the landers—who are not continually employed—do not represent accurately the cost of this item. Still it is necessary to study some cases of intermittent drawing, since this condition is that of the majority of the workings.

These are the points upon which information is ordinarily most wanted. There is no special account kept of the maintenance of the shafts in repair, as this varies widely according to circumstances, and depends in a great measure on the accidents resulting from the breakages of the chains or ropes. Indeed few connected with the working of a mine care to look too closely at this point. The cost of labour and of material consumed is not the same at all mines or at all times; so that data which give only the cost without the quantities cannot be properly compared.

In many mines the charges for filling and landing include the surface cartage or tramming of the ores from the shafts to the floors, and sometimes even include a certain proportion of the underground tramming—under which circumstances discrepancies appear which do not really exist.

To the special items of cost given above, it would be satisfactory to add a charge for the wear and tear and the redemption of the cost of the original erections. This could be easily arrived at in the case of the engines, and the various mechanical apparatus; but that of the various shafts is scarcely capable of estimation.

§2. *Description of the various Methods in Use.*

The methods of drawing in use may be classed into two systems, according as the kibble or skip is employed. In the first, which is the oldest, the *kibble* hangs loose in the shaft, or is dragged along its walls; while in the second the *skip* works in guides with wheels or friction bars.

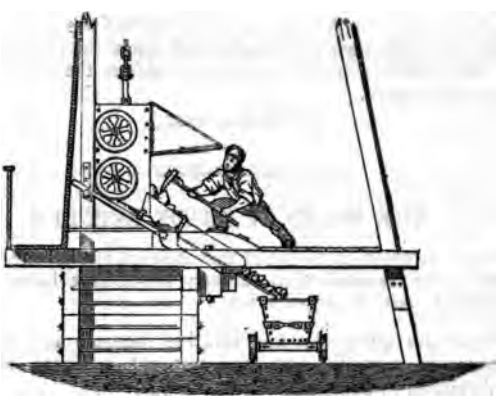
The Wrought-iron Kibble.—The kibble, which is of various forms, is alone used with hand-tackles or horse whims;* and with steam engines its use is

* Skips worked by horse-whims have recently come into use and are now employed at several mines in Cornwall.—Ed. M. & S. M.

still continued, not only in small and irregular shafts, but also in large shafts both inclined and vertical. Indeed in some of the largest and deepest mines (such as Dolcoath and Fowey Consols) this system is advisedly clung to. The kibble is drawn by chains or flat or round ropes, but never by wire ropes. The use of flat rope is reserved for vertical shafts (Fowey Consols); and round ropes are only used for moderate depths, with horse-whims and hand tackles, and in sinking winzes underground. On the whole, with kibbles, chains are most frequently used, either with horse-whims or in deep and variously inclined shafts.

The guided prismatic Skip.—The skip, like the kibble, never leaves the shaft but to be repaired. It has the form of a rectangular prism truncated obliquely towards the base, as shown in the accompanying section, Fig. 18. The top is left open for the filling in of the ore; and the lower base forms an inclined plane, upon which, on the lander opening the side of the skip, the matters drawn slide out and fall in the direction of the waggon, as shown in the figure.

FIG. 18.



The details of the construction of the skip, and the arrangements as to the guidage, are very various. In vertical shafts the skips have no wheels. At the United Mines the wooden guides are arranged so as to form a groove, in which the cross pieces, bolted to the back of the skip, slide. In inclined shafts generally the skip has four wheels; the axles are fixed on the lateral faces, but there is no axle traversing the skip. In the greater number of mines the wheels (which have a plane cylindrical face) work on two wooden guides (four in the shaft), all displacement being prevented by transverse bars bolted on to the back of the skip (Wheal Buller, Stray Park, Carn Brea, South Frances). But in some shafts particularly those where the underlie changes, the skips are without bars, but have eight guides in the shaft: the wheels have flanges like those of the tram-waggons, each of which works between two guides (Levant). At Devon Consols the guides are faced with light rails, so that the skip runs, as it were, between two railways.

An attempt has been made to avoid having more than four guides, without having recourse to the transverse friction bars. In this case the skip has eight small wheels, four on the lateral face of each guide, which is confined between them (Providence Mine, Boswedden, Camborne Vean). This system is not one to be imitated.

The guides are almost everywhere of wood, but, as in the instance of Devon Consols, they are sometimes faced with rails, which is necessary in

the case of shafts having but a small dip from the horizon (West Wheal Seton). As to inclined planes, properly so called, they evidently require an ordinary railway waggon (Wheal Friendship); but they are little used. In 1858 at Wheal Union, near Redruth, there was an example (the only one known in Cornwall) of guiding by wire rope in a vertical and not very deep shaft. The skip had pieces of wood attached to its sides which were pierced with a hole through which the rope passed. The unavoidable falling of the quartzose particles into this hole necessarily led to the rapid destruction of the rope, while the deepening of the shaft required its lengthening, so that on the whole its trial was unsatisfactory.

Skips are drawn with chains, flat hemp ropes, and round wire ropes; flat wire ropes have not been tried. Each of these modes has zealous partisans; but it suffices to say that at present the chain prevails in certain shafts that are in bad condition, that hemp is preferred when the shaft admit of its use, and lastly that wire rope, whose adoption is comparatively recent, maintains its place with difficulty and is yet far from triumphing.

The motive-engines and accessory apparatus present many variations which will be mentioned further on; but, saving the question of power, the nature of the motive-engine is not mixed up in the controversy between kibbles and skips, chains and wire ropes, which are the principal points at present under discussion.

(To be continued.)

THE BOARD OF TRADE RETURNS.

The "Accounts relating to Trade and Navigation of the United Kingdom, for the month ended 31st January 1863, have been issued by the Statistical Department, Board of Trade.

IMPORTS.—The quantities and relative increase and decrease of the imports of metals, metallic ores, and mineral products, for the month ended 31st January, have been as follows:—

	Month ended 31st January.		
	1862.	1863.	Increase (+) or Decrease (−)
Brimstone .. .. cwts.	36,791	17,418	− 19,373
Copper Ore .. .. tons	5,712	4,238	− 1,474
Copper Regulus .. .. .. „	533	2,176	+ 1,643
Copper, unwrought and part wrought cwts.	3,760	3,180	− 580
Iron, in Bars, unwrought .. .. tons	297	521	+ 224
Steel, unwrought .. .. .. „	56	13	− 43
Lead, Pig and Sheet .. .. .. „	480	612	+ 132
Spelter or Zinc .. .. .. „	337	726	+ 389
Tin, in Blocks, Ingots, Bars, or Slabs cwts.	2,316	—	—
Petroleum Oil.. .. .. .. tuns	8	497	+ 489
Silver Ore .. .. .. value in £	32,170	8,050	− 24,120

EXPORTS.—The quantities, declared value, and relative increase and decrease of the exports of metals, minerals, and metallurgical articles of British and Irish produce and manufactures, for the month ended 31st January, have been as follows:—

		QUANTITIES.		DECLARED VALUE.		
		Month ended 31st January.		Month ended 31st January.		
		1862.	1863.	1862.	1862.	Increase (+) or Decrease (−)
				£	£	£
Alkali: Soda	cwts.	115,497	124,703	47,046	51,219	+ 4,173
Coal, Cinders, and Culm	tons	500,569	454,784	234,138	217,463	− 16,675
Iron, Pig and Puddled	,,	23,548	26,799	64,991	73,301	+ 8,310
Iron, Bar, Angle, Bolt, and Rod	,,	18,205	20,991	126,920	153,062	+ 26,142
Railroad Iron, of all sorts	,,	14,564	22,685	107,670	161,148	+ 53,478
Iron Wire	,,	416	1,490	11,351	27,292	+ 15,941
Iron, Cast	,,	3,802	4,979	42,082	38,303	− 3,779
Iron Hoops, Sheets, and Boiler Plates	,,	4,689	6,445	44,957	60,399	+ 15,442
Iron, wrought, of all sorts	,,	6,483	6,488	148,414	132,361	− 16,053
Iron, Old, for remanufacture	,,	43	579	115	2,051	+ 1,936
Iron, Steel, unwrough	,,	1,514	1,729	50,324	53,905	+ 3,581
Copper, unwrought, in Ingots, Cakes, or Slabs	cwts.	6,430	5,568	34,230	26,985	− 7,245
Copper, wrought or partly wrought, Bars, Rods, Bottoms, Pans, Plates, Sheets, and Nails; and mixed or Yellow Metal for Sheathing	,,	18,298	19,636	91,046	94,755	+ 3,709
Copper, wrought, of other sorts	,,	2,147	594	14,785	3,372	− 11,413
Brass of all sorts	,,	3,420	2,009	18,608	10,616	− 7,992
Lead, Pig, Rolled, Sheet, Piping, Tubing, and Lead Shot	tons	1,009	1,694	21,543	37,090	+ 15,547
Lead Ore, Lead, Red and White and Litharge of Lead	,,	401	248	9,543	6,403	- 3,140
Tin, unwrought	cwts.	3,845	4,512	22,492	26,051	+ 3,559
Tin Plates	,,	54,678	60,752	64,283	71,155	+ 6,872
Zinc or Spelter, wrought or unwrought	,,	2,801	5,086	3,069	5,410	+ 2,341
Salt	tons	35,304	20,517	17,117	9,953	− 7,164
				1,174,724	1,262,294	+ 87,570

Notes and Memoranda.

THE HARTLEY RELIEF FUND.—A meeting of the general committee of this fund was held at Newcastle-on-Tyne, the executive committee presented a report of their proceedings hitherto, in which is embodied a scheme for the disposal of the surplus. The financial statement shows :—

	£	s.	d.	£	s.	d.
Total amount of subscriptions received	81,838	19	5			
Interest on investments and current accounts ..	1,395	18	4			
				83,234	17	9
Tradesmen's accounts, recovering bodies	181	16	4			
Burial of bodies	76	9	8			
Grant to sinkers' fund, in accordance with the expressed wish of many subscribers ..	300	0	0			
Allowances to widows, orphans, and others 5,079 3 0						
Medical attendance 88 13 11						
Removal of widows and leading coals. 183 16 9						
Marriage portions 138 16 0						
Education, including a grant of 200*l.* for school-room 317 16 6						
Outfits for children 14 0 0						
Allowances in respect of births and deaths 44 16 0						
	5,867	1	2			
Grants to able-bodied parents, &c., in respect of sons and other relatives lost	308	0	0			
Advertising subscriptions, printing, &c.	901	14	0			
Expense of management, including office rent and furnishing .. 130 13 8						
Incidentals 27 1 6						
	157	15	2			
				7,792	16	8
Leaving balance this date, Feb. 24, 1863 ..				£75,442	1	1

Of this sum 70,000*l* has been invested in railway and other debentures, in compliance with resolutions of the general committee—viz., with the North-Eastern Railway Company, at 4 per cent., 20,000*l.*; with the Newcastle and Carlisle Railway Company, at 4 per cent., 20,000*l.*; with the Blyth and Tyne Railway Company, at 4 per cent., 10,000*l.*; with the River Tyne Commissioners, at 4½ per cent., 20,000*l.*; and the balance, 5,442*l.* 1*s.* 1*d.*, is in the hands of Messrs. Woods and Co., at bank interest.—Total, 75,442*l.* 1*s.* 1*d.*

As we stated last month, Mr. Birkmyre, the actuary, who has calculated the lives, estimates that 50,400*l.* will be required for affording the necessary relief to the persons for whom the fund was subscribed. The executive propose to add to this 4,571*l.*, in order to meet several important items not included in Mr. Birkmyre's estimate, such as education of the children, medical attendance, &c., &c. This would bring the total sum to be retained to 55,000*l.*, leaving a surplus of 20,440*l.* It was resolved that the committee should meet and decide as to the application of this later in the month.

MICA LAMP CHIMNEYS.—M. del Campo states that an application of mica to lamp chimneys has attracted his attention on the Continent. The advantages of these chimneys are that they neither crack from a sudden

change of temperature, nor break from falling down. These chimnies have come into general use on the Continent.

Coal-Tar Colours.—In printing and dyeing with aniline and analogous coal-tar dyes, Mr. Alex. Schultz proposes to employ as a mordant arsenious acid, or a compound thereof, and this he uses in combination with alumina. In printing he prefers to mix together arsenite of soda, acetate of alumina, and the dye, then to print the fabric with this compound, and afterwards to steam it; the several materials may, however, be applied separately. In dyeing, the fabric is first submitted to the arsenite of soda and acetate of alumina, and then to the dye. Salts of antimony or tin may be substituted for those of arsenic, and acetates of zinc and magnesia may be used instead of that of alumina, but the result is not equal.

The Miners' Association of Cornwall and Devon.—A meeting of this association was held at Camborne, on March 3rd, the president, Mr. Basset, in the chair. It was resolved, that managers of mines be requested to communicate with the council of the association on the best method of connecting the association with evening schools, in order that those who should become members of classes might previously have had an opportunity of obtaining such a rudimentary education as would assist them in mastering the lessons given by the association.

Mining, Quarrying, and Metallurgical Review.

WESTERN COUNTIES.

The standard of copper ore has improved a little on the closing rates of last month, although not materially. The tin standard still remains stationary; but as the markets for this metal are very good, an advance is confidently anticipated.

In Cornish and Devon mines there is no very material alteration. *East Caradon* has had a heavy drop in market value, but is still far from having fallen to its true position. Those who were influenced by the statements made at the last meeting, that a dividend of 25*s.* might be expected at the next account, will shortly be able to satisfy themselves of the value to be placed on statements from that quarter. East Caradon never should have gone beyond a 10*s.* dividend, at which rate of working the mine could have been carried on steadily and respectably for a considerable time. Instead of this, a system of pushing the mine to the very utmost for a short time has been adopted. Such a system is not wholly unknown in Cornwall, but never before has it been pushed to such an extent. Indeed such a thing could not have occurred in West Cornwall, where mining is really understood; and in this case is only possible from the preponderance of "outside" shareholders, utterly ignorant of the points that constitute the value of a mine.

An arbitration of some importance is pending between *Tincroft* and *Cook's Kitchen* mines to ascertain the value of the tin-stuff taken away by the encroachment of the latter mine on the former. The position of the workings on the two mines is shown in Plate III, where the ground encroached on (between the 148 and the 160, and the 160 and the 190, in Cook's Kitchen) is shown as worked away. These encroachments were effected some years ago, by tributers, without the knowledge of the Cook's Kitchen adventurers, and have only been recently discovered by the mines being holed to each other.

The tin mines in the Wendron district are looking better than they have been for some time past. At *Wendron Consols* the 90 west of Hills is worth 20*l.* per fathom; and the 80 and 90 east also continue to look very well. Hill's shaft has been commenced sinking below the 90; and as that level opened out much better than the 70 and 80, the propects of this part of the mine in depth seem very good. *Basset and Grylls* also—to which we directed the attention of our readers more than twelve months ago as being one of the most promising mines in the district—continues to look well, and will sell this quarter nearly 80 tons of tin, notwithstanding the collapse of the boiler of the steam whim, which hindered the drawing of the stuff at Wheal Fat for about a week, but which has now been set right for some time. The present price at which this mine is selling is however a fair one according to present prospects. At *New Wendron* (a sett adjoining Wendron Consols and Basset and Grylls on the west) there is also an improvement. The 10 fathom level west on Penaluna's lode is opening out tribute ground, and the flat-rod shaft is also sinking through a lode that will work to profit. In the 20 east from Grenfell's also, there is a good leader of tin, both in the east and west ends. Stamps will be erected forthwith on this mine, where there is water available. At *Trevenen and Tremenheere* also the prospects are very cheering, and the bottom level is opening up in such a manner as to afford a fair prospect of its becoming a profitable mine. At *Trumpet Consols* the old Wheal Dream Mine, which has been full of water for several years, is being cleared out; and this of course is a heavy drain on the resources of the part now working, which otherwise no doubt would be giving profit. When this has been completed and the bottom of the old mine has been reached, there is no doubt this mine will again resume dividends. At *Trumpet United* there has also been an explosion, and a more serious one than at Basset and Grylls, for it literally tore the tube off the boilers. An accident like this is of course injurious to a poor mine; but if worked with economy and perseverance there is still a fair prospect of this mine being made remunerative. At *East Wheal Lovell* there was a good bunch of tin some little time since, but about three weeks ago it failed; the mine however is now looking better again. *Treworlis* is still poor for tin, but there is a large lode producing low-priced copper. This is a highly mineralised piece of ground and with perseverence and judgment ought to make a mine. *Calvadnack* is looking better, but there does not seem to have been any alteration in the mine proportionate to that that has taken place in the price of shares. *Wendron United* is also said to be slightly improved. *Garlidna* is unfortunately still poor, but there is a point or two of some importance at the 70 and 40 west of flat rod shaft.

At *East Russell* meeting (February 26) it was resolved that application be made to His Grace the Duke of Bedford for a reduction in the rate of dues; and that Captain Goldsworthy be requested to telegraph to the Company's offices any important change in the mine. At *West Devon Consols* meeting (February 24) it was resolved to issue *pro rata* to the existing shareholders 10,000 of the unallotted shares, at 10*s.* per share. The recent discovery in West Maria and Fortescue was considered of great importance, as indicating the value of the same lode in this sett. At *Falmouth and Sperries* meeting (February 19) the purser was directed to apply to Lord Falmouth for an abatement of the dues. At *Wheal Hearle* meeting (February 25) it was resolved that the agents should vouch the merchants' bills with the delivery of the goods on the mine, and that a plan of the underground workings should be lithographed together with a plan of the surface, showing the position of the "guide" and other lodes, and circulated among the shareholders. The question of the appointment of a Finance committee was postponed till the next meeting to be held in London. At *Rosewarne Consols* meeting (February 24) it was resolved that

a suitable engine be erected. At *North Roskear* meeting (March 12) it was resolved that the western part of the sett be worked as a new mine, under the name of Roskearnoweth, to be divided into 700 shares and allotted *pro rata* to the shareholders in North Roskear; and that steam-stamps be erected at Wheal Crofty old mine. At *Wheal Trerew* meeting (March 24) the shares were subdivided from 512 into 2,048. At *West Basset* account (March 25) the accounts showed a payment of 1,866*l.* 14*s.* 9*d.* damages and costs in the cause of *Reynolds* v. *Buckley*, in respect of the litigation between this mine and South Frances. At *Wheal Grylls* meeting (March 25) a testimonial was presented to Mr. Peter Watson for the services in the interest of the concern.

WALES AND THE BORDERS.

South Wales.—The iron trade has not been quite so brisk this month as it was last, the large purchases made two months ago having affected the trade to a considerable extent. It is expected, however, that an improvement will take place before the next quarter-day, as the orders for the Northern States are increasing, and the early opening of the Baltic cannot fail to benefit the trade. The Nantyglo and Beaufort Works have been very actively employed, and, indeed, have had so many orders that they have been obliged to get some of them executed elsewhere. There has been a large demand for bars and rails from France, Spain, Russia, and other continental states.

The coal trade has been fairly active although the high freights and the difficulty of obtaining vessels, even at the increased rates, continue to retard the trade to some extent. Many of the collieries are in consequence but partially employed, and until more ships arrive this state of things is likely to continue.

From shipping returns it appears that a good business was done in the South Wales shipping ports during the month of February. The number of ships that cleared out of Cardiff for foreign ports amounted to 331, a considerable increase on last year.

The number of ships entering Swansea during February was 397, with a registered aggregate tonnage of 51,888 tons.

At Neath an average trade has been done; at Llanelly there has been a good business done, both foreign and coastwise.

North Wales.—The only new company advertised since our last is the *Clogau Consolidated Gold Mines Company*, with a capital of 120,000*l.*, in shares of 2*l.* each.

Gloucestershire.—The imports into Bristol during the past month include 425 tons of pig-iron from Glasgow; 300 tons of sulphur ore from Pomaron; 280 tons of sulphur ore from Arklow; 96 tons of lead ore from Padstow; 26 casks of metal from Rotterdam: and 3,387 bars iron from Gothenberg. Among the exports, 150 tons of coal, and 300 tons of iron. The customs receipts during February amounted to 107,989*l.* 7*s.* 9*d*; being the largest receipt for this month on record.

The *West of England Coal and Iron Company*, with a capital of 100,000*l.* in shares of 5*l.* each is in course of formation. It is formed for the purpose of working several mines in the Forest of Dean.

NORTHERN COUNTIES.

Northumberland and Durham.—The iron trade has been very active in this district with every prospect of a continued improvement. New Establishments in South Durham and Cleaveland are about to be commenced, and the manufacturing and export houses are busy with the spring

orders, which have been more numerous than was expected. New rolling mills are about to be erected at Darlington.

The coal trade has been very dull, and a great many pits have been working short time.

The imports into the Tyne include: cargoes of pyrites from Huelva, Pomaron, Antwerp, Bergen and Seville; copper ore from Bergen; sulphur, pyrites and copper ore from Seville; 8,662 bars of lead from Carthagena; 730 tons of iron and a quantity of sulphur ore from Pomaron; manganese ore from Lago; and pit-props and bar iron from Gothenberg. Among the exports were: 97,769 tons of coal; 29,253 cwts., of iron; and 6,372 tons of coke.

An explosion of fire-damp occurred at Oxlodge Colliery, Northumberland, on Friday the 7th, by which 20 men were killed and 2 injured.

MIDLAND COUNTIES.

STAFFORDSHIRE AND WARWICKSHIRE.—The iron trade in this district is slightly improved. There have been few orders for bars, and hoops are not in good demand. The most encouraging feature of the trade has been the demand for railway iron. There have also been some orders for America.

The demand for coal for manufacturing purposes has been good, but there has not been so much pressure on the Collieries and it is feared that prices will shortly decline.

The preliminary meeting of the South Staffordshire and Worcestershire Ironmasters' Association has been held at the Hen and Chickens, Birmingham, on the 26th, Mr. Phillip Williams, the chairman, presiding. There was a tolerably good attendance of the leading firms, who alone compose the association. As anticipated, no change took place in prices, which remain at 7*l.* for bars, and other sorts in proportion.

The trade is rather quiet, but some parties state they have had a few more orders within the last day or two. There can, however, be no question that the demand is less active than in January, and that the anticipations then very generally entertained of an improvement have not been realised.

The puddlers west of Dudley in several instances gave notice on Saturday the 21st, for an advance of wages. The matter was mentioned at the meeting to-day, and an unanimous opinion was expressed that the demand is altogether inadmissible. The trade is slack, prices are lower than when the last reduction was made in wages, and there is by no means a deficiency of labour. An attempt was made by the puddlers near Westbromwich a fortnight ago to secure an advance, but after a week's play—which was rather convenient to the masters than otherwise—the men went in again, and this is sure to be the case in the present instance. No doubt wages are low, but so are prices and profits.

DERBYSHIRE.—The demand for good iron has increased, and the augmented demand is felt sooner on account of the lowness of stocks. Bars and plates have been in good request, and a very considerable demand for rails is anticipated owing to the construction of new lines.

The coal trade has been a little brisker; and the Derbyshire coal is in increased demand for gas making.

SCOTLAND.

Coals have been in moderate request for home use and for shipment, but the exports show a slight decrease on the same period last year.

The pig iron market has been dull and prices have declined.

THE CONTINENT.

FRANCE.—Business has been quieter in copper at Paris, but prices have been maintained. The market for tin has been rising; Banca has been quoted at 127*l.* and English 118*l.* The price of lead has not declined though there has been little demand. In the Haute-Marne district quotations for pig-iron are firmer and prices have risen. At St. Dizier the demand for iron is trifling. There is some talk of the foundation of metallurgical establishments in the centre of France, by a company which would carry on simultaneously coke furnaces, blast furnaces, and rolling works.

It appears from official returns that the iron works in France, which in the year 1847 produced only 591,590 tons of cast iron, produced 856,152 tons in 1859, 888,000 tons in 1860, and 1,053,000 in 1862, notwithstanding the importation of 160,000, tons of English cast metal. In 1847 the French iron masters turned out only 376,687 tons of wrought iron. In 1859 the yield reached 520,099 tons; in 1861, 572,700; and in 1862 7000,500 tons, although the wrought iron imported from England amounted to 122,000 tons. The consumption of coal has increased in the same proportion. In 1847 it did not exceed 7,648,875 metrical quintals, of which 5,153,205 quintals were the produce of French coal mines. The consumption increased to 13,063,662 quintals in 1859, of which 8,482,572 were French. In 1860 the produce of the French coal mines decreased to 8,039,109 quintals. In 1861 it rose again to 8,400,000 and in 1862 to 9,400,600 quintals. This increase is attributed to the duty on foreign coals having been reduced, by which the proprietors of coal mines were stimulated to increase their production.

The prospectus of the *St. Maurice Mining Company*, with a capital of 100,000*l.* in shares of 30*l.* each has just been issued. The object of the company is to purchase three-fifths of the interest in the St. Maurice Mines, at Valgodemard, in the High Alps, which is said to extend over 5,155 acres, and to contain zinc, iron, copper, and antimony, and small percentages of lead, and silver.

BELGIUM.—At Charleroi business has been done at 3*l.* 16*s.* per ton; hard 3*l.* 4*s.* per ton. The following is a summary of the exports and imports of Belgium during 1862;—

	Exports.	Imports.
	Tons.	Tons.
Coal	3,290,595	78,817
Iron ores	1,987,566	1,127,736
Rough pig	34,602	5,468
Manufactured cast-iron	3,133	92
Iron, in bars	23,234	1,282
Rails	45,353	40
Plates	8,211	13
Iron-wire	1,402	359
Nails and points	11,862	36
Engines and machinery	14,838	2,879
Manufactured wrought iron.. ..	2,537	429
Steel	322	2,374

SPAIN.—A prospectus has been issued of the *Alamillos Company*, with a capital of 70,000*l.* in 35,000 shares of 2*l.* each, for purchasing and working the lead mines of Alamillos, situated parallel with and between the mines of Linares and those of the Fortuna Companies, and smelting the ores and

desilverising the lead in Spain. The managers are Messrs. John Taylor and Sons.

ITALY.—A company called the *Vallanzasca Gold Mining Company* has also been introduced, with a capital of 50,000*l.*—50,000 shares of 1*l.* each. The object is to work the gold mines of Dei Cani, near Vallanzasca, in the province of Domo D'Ossola, Italy.

PATENTS RELATING TO MINING AND METALLURGY.

ABSTRACTS OF SPECIFICATIONS.

MANUFACTURE OF GAS AND COKE.—Letters patent have been granted to MM. A. J. Moreau and A. E. Ragon, of London (No. 2,234), for "improvements in the manufacture of gas and coke." This patent relates to the manufacture of gas from peat or from chemical substances contained in peat, but may also be advantageously employed for obtaining gas from coal or other substances from which it may be generated. The chief point in the invention consists in the use of a second system of retorts, through which the various volatile products produced in the first retorts, are passed over a layer of red-hot coke; by this means the water from the peat is decomposed with the production of carburetted hydrogen. It is said that the coke produced by this method is more porous and freer from volatile matter than ordinary gas coke.

MACHINERY FOR VENTILATING MINES.—Letters patent have been granted to Messrs. R. Ridley, of Yorkshire, and J. G. Jones, of Battersea, Surrey (No. 2,027), for "improvements in machinery and apparatus for ventilating mines." For this purpose a peculiar description of fan is placed at the top of the up-cast shaft, the central opening of which is on the under side, and its diameter corresponding to that of the shaft. This fan consists of two plates or covers, the under one having the opening through it, and the upper one being closed: to the latter is fixed an axis or vertical shaft which rotates in a step bearing, supported on timbering fixed across the shaft; the upper end of this axis turns in a suitable bearing outside the apparatus. The periphery of this fan has openings in it which radiate from the centre; these openings are formed by curved plates, each of which springs from the inner end of one opening to the outer end of the next. The apparatus is made to rotate at a considerable velocity, thereby drawing the air up the shaft, and causing it to flow out through the several openings in the periphery of the fan.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Feb. 7, 1863. 353. D. Groucutt, of Couley, Stafford, "Improvements in the manufacture of iron and making nails."

„ 9, „ 355. H. G. Williams and R. Price, of Boulddu, near Dolgelly, Merioneth, "An improved machine for crushing and amalgating auiferous quartz; and pulverizing and washing ores."

Jan. 21, „ 193. H. Holcroft, of Rue de la Grandierè, Tours, France, "Improved machinery for separating substances of different specific gravities."

Feb. 13, „ 385. G. H. Birkbeck, of 34, Southampton-buildings, London, "Improvements in processes or means employed for separating or extracting silver or other metals from lead." A communication from M. Clement Roswag, Paris.

„ „ 388. Jabez Jones, of Liverpool, "Improvements in the manufacture of lead, tin, or other metals, or amalgamation of metals of a like fusible nature into sheets of any required thickness and length, and also coating one or both sides of pipes and sheets of lead and other metal or amalgamation of metals with tin or other substances, and in the apparatus connected therewith."

„ 3, „ 307. W. G. Valentine, of the College of Chemistry, London, and Frederick Levick, of Blaina, Monmouth, "Improvements in

generating combustible gases, and in the apparatus employed therefor."

Feb. 18, 1863. 313. George Haseltine, of 12, Southampton-buildings, London, "Improvements in the mode of uniting metallic surfaces." A communication from W. B. Barnard, of New Haven Connecticut, U. S.

„ 21, „ 485. W. H. Gauntlett, of South Bank Iron Works, Middlesbro'-on-Tees, "Improvements in apparatus for heating the blast in the manufacture of iron."

„ 24, „ 501. George Davies, of No. 1, Serle-street, Lincoln's-inn, London, "An improvement in melting and smelting furnaces." A communication from J. F. Stileman and Z. Ellis, of Philadelphia, U.S.

„ 25, „ 522. E. B. Wilson, of 5, Parliament-street, London, "Improvements in the manufacture of alloys of titanium and iron."

„ 7, „ 342. J. Cameron, of the Hematite Iron Works, Barrow-in-Furness, Lancashire, "Improvements in the manufacture of iron and alloys of iron."

„ 27, „ 560. Victor Désiré Delahaye, of 7, Cauchoise-street, Rouen, "Improvements in apparatus for cleaning and excavating pit coal and rock or earth."

„ 28, „ 568. S. Williamson, of Sheffield, "Improvements in the construction of furnaces."

„ „ 534. George Tomkins, of Morriston, Glamorgan, "Improvements in the manufacture of tin and terne plates, and in the apparatus to be employed therein."

„ 26, „ 546. James Humby, of 14, Gresham House, London, "Improvements in furnaces and apparatus for manufacturing oxide of zinc or zinc white." A communication from H. Felsch, of Witten, Westphalia.

Mar. 5, „ 625. Ed. B. Wilson, of 5, Parliament-street, London, "Improvements in the manufacture of steel, and in the apparatus employed therein."

„ 9, „ 646. Robt. Mushet, of Coleford, Gloucestershire, "An Improvement in the manufacture or treatment of pig or cast-iron."

„ 12, „ 679. James Polkinghorne, of Redruth, Cornwall, "Improvements in treating tin ores, and in apparatus for treating ores and matters containing arsenic."

NOTICES TO PROCEED.

Oct. 3, 1862. 2675. Alex. Dalrymple, of 18, Eyre-street, Sheffield, "Improvements in the processes of depositing metals by galvanic action, either with or without the aid of galvanic batteries, and in the ornamentation of metal surfaces thereby."

„ 28, „ 2203. Ed. S. Tudor, of Upper Thames-street, London, "Improvements in the purification of lead."

„ 7, „ 2711. J. K. Hampshire, of Whittington parish, Derby, "Improvements in apparatus or machinery for washing coal, coal slack, and other mineral substances, and separating foreign particles therefrom.

„ 29, „ 2909. George Darlington, of Minera, Denbigh, "Improvements in the manufacture of zinc oxide."

„ „ „ 2913. Wm. Clark, of 53, Chancery-lane, Middlesex, "Improvements in the treatment of copper ores, and in apparatus for the same."—A communicatiom from M. F. Le Clerc, of 29, Boulevart, St. Martin, Paris.

„ 17, „ 2087. G. T. Bousfield, of Brixton, Surrey, "Improvements in the manufacture of iron and steel."—A communication from G. F. Göransson, of Gefle, Sweden.

Nov. 26, „ 3175. A. V. Newton, of 66, Chancery-lane, London, "An improved mode of preparing oxide of zinc as a pigment."—A communication from Geo. Lewis, of Philadelphia, U.S.

Jan. 19, 1863. 157. E. Sabel, of Moorgate-street, London, "Improvements in the manufacture of artificial stone." —A communication from J. Sepulchre, of Huy, Belgium.

Oct. 31, 1862. 2831. Saml. Witham and Thos. Wright, of the Calder Vale Iron Works, Wakefield, "Improvements in the manufacture of iron and steel, and in the apparatus employed for that purpose."

„ 31, „ 2952. Wm. Jenkins, of Troedy Rhiw, Merthyr Tydfil, "An improved mode of, and apparatus for cutting coal."

Nov. 4, „ 2988. Arthur Wall, of Poplar, London, "Improved processes for purifying lead, and extracting and separating silver therefrom, and in machinery for those purposes."

„ 5, „ 2996. C. Shield, of Newcastle-on-Tyne, "Improvements in the manufacture of malleable cast iron."

Nov. 8, 1862. 3021. Ed. Sonstadt, of Nottingham, "Improvements in the Manufacture of the metal magnesium."

Jan. 13, 1863. 113. J. B. Rock, of Pilton, near Barnstaple, "Improvements in apparatus for saving life and property from fire and other danger in buildings and mines."

„ 31, „ 291. E. B. Wilson, of Parliament-street, London, "Improvements in supplying air, gases, steam, or fluids, to iron and other furnaces, and to engines and vessels requiring such supply, and in the apparatus employed therein."

PATENTS SEALED.

Feb. 10, „ 2410. J. H. Johnson, of 47, Lincoln's-inn-fields, London, "Improvements in coating or covering metallic surfaces with copper."—A communication from C. F. L. Oudry, of Paris. Dated 30th August, 1862.

„ 13, „ 2335. J. C. Schenmann, of Hamburg, "Improvements in the manufacture of steel." Dated 21st August, 1862.

„ „ „ 2341. S. F. Griffin, of the New Adelphi Chambers, London, "Improvements in apparatus to be used in the distillation of petroleum, or any oleaginous, resinous or alcoholic bodies." Dated 22nd August, 1862.

„ 24, „ 2379. R. A. Brooman, of 166, Fleet-street, London, "Improvements in machinery for separating or sorting and washing, coal and other minerals."—A communication from M. Evrard, of St. Etienne, France. Dated 27th August, 1862.

„ 27, „ 2441. R. A. Brooman, of 166, Fleet-street, London, "Improvements in tools for boring, and in apparatus for working the same." —A communication from J. R. Leschot, of 16, Rue St. Louis, Paris. Dated 3rd, September, 1862.

Mar. 6, „ 2518. A. J. Moreau, of Sherborne-street, Blandford-square, London, "An improved mode of, or process for reducing or melting pulverized metals or metallic ores." Dated 12th September, 1862.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

Feb. 26, 1863. 578. Hy. Bessemer, of Queen-street-place, New Cannon-street, London, "Improvements in machinery or apparatus employed in the manufacture of malleable iron and steel." Dated 1st March, 1860.

„ 27, „ 542. Robt. Walker, of Eccleston, Lancashire, "Improvements in apparatus for preventing accidents in winding from mines, which apparatus is also applicable for other similar purposes." Dated 28th February, 1860.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

Feb. 26, 1863. 630. Hy. Bessemer, of Queen-street-place, New Cannon-street, London, "Improvements in the manufacture of iron and steel." Dated 15th March, 1856.

PATENTS WHICH HAVE BECOME VOID BY THE NON-PAYMENT OF THE DUTY OF £50.

Feb. 7, 1863. 278. J. Gedge, of Wellington-street, Strand, London, "Improvements in amalgamating metals or producing alloys."—A communication from J. Aich, of Venice. Dated 3rd February, 1860.

" " " 329. Edmund Lea, of West Bromwich, Stafford, "Improvements in the manufacture of iron and steel tubes." Dated 7th February, 1860.

" 21, " 460. A. C. Hill and Wm. Morgan, of Whitton-park Iron Works, near Darlington, "Improvements in protecting the sides and ends of puddling furnaces." Dated 20th February, 1860.

" 28, " 488. Wm. Haynes, of Bank-place, Holywell, Flint, "Improvements in obtaining metals from their ores or matrices." Dated 23rd February, 1860.

" " " 514. E. T. Hughes, of 123, Chancery-lane, London, "Improvements in boring apparatus."—A communication from Geo. Kolb, of Bayreuth, Bavaria. Dated 25th February, 1860.

" " " 544. Z. Wright, of Upper Wortley, near Leeds, "Improvements in machinery or apparatus for the prevention of accidents in mine shafts by the breaking of the rope or chain, or disconnection of the drum from the engine, applicable also to other hoisting or lifting machinery or apparatus." Dated 28th February, 1860.

Mar. 7, " 574. J. McCulloch, of San Francisco, U.S., "Improvements in the reduction of gold, silver, and copper ores." Dated 1st March, 1860.

" " " 588. X. Mousty, of 29, Boulevart, St. Martin, Paris, "An improved apparatus for washing ores." Dated 3rd March, 1860.

" " " 616. Wm. Buxton, of Staveley, Derby, "Improvements in safety cages for mines." Dated 26th March, 1860.

PATENTS WHICH HAVE BECOME VOID BY THE NON-PAYMENT OF THE DUTY OF £100.

Feb. 14, 1863. 359. R. A. Brooman, of 166, Fleet-street, London, "Improvements in the manufacture of cast steel." Dated 12th February, 1856.

" " 385. E. Morewood and Geo. Rogers, of Enfield, Middlesex, "Improvements in drying and coating iron and copper." Dated 14th February, 1856.

" 28, " 514. Ch. A. de Foubonne, of Paris, "Improved apparatus for the manufacture of coke and for blasting, also for the production and extraction of illuminating and combustible gas, as well as ammoniacal and bituminous matters, part of such apparatus being applicable to the consumption of smoke." Dated 28th February, 1856.

APPLICATION FOR THE RENEWAL OF PATENTS.

Mar. 20, " 209. Thos. S. Prideaux, of 209, Piccadilly, "Improvements in puddling and other furnaces." Granted 30th August, 1849.

Metal Markets.

LONDON, *March 28th.*—The metal market has been steady all through the month, a fair amount of business has been done, and prices have been well maintained.

IRON.—The iron trade has been quiet, but prices have not declined.

The Scotch pig-iron market has been very dull at declining rates. The opening price was 54*s.* to 55*s.* but towards the end of the month there was

an almost uninterrupted fall, and prices closed at 51*s.* 4½*d.* to 51*s.* 6*d.* The exports during the month amounted to 45,481 tons, against 41,584 tons during the corresponding period last year—showing an *increase* of 3,897 tons.

Welsh bars have been very quiet at unaltered quotations, 5*l.* 12*s.* 6*d.* in Wales, 6*l.* 5*s.* f. o. b. in London. Staffordshire descriptions have been in good steady demand for shipment at full prices, and manufacturers have been fairly supplied with orders, especially in hoops. Swedish bars have been in very limited supply, but owing to the trifling demand prices have not yet advanced. Ordinary specifications 11*l.* 15*s.*; fine sizes 12*l.* and upwards.

STEEL.—There has been more enquiry for Swedish keg. at 15*l.* 10*s.* to 15*l.* 12*s.* 6*d.*

COPPER.—The market for English has been firm, and official prices have been maintained; there has also been a fair demand for manufactured.

Very little business has been done in foreign. Burra Burra 94*l.* to 95*l.* Kapunda 95*l.* to 96*l.* Spanish 85*l.* 10*s.* Chili 83*l.*

YELLOW METAL.—This article has been in good ordinary request at 7¾*d.* to 8*d.* for braziery sheets, sheathing 8¼*d.*

TIN.—English has been in good demand at fixed rates, and it is expected that an advance will soon take place. Since the news of the falling off in the production of Banca tin, amounting to 40,000 slabs; the market for foreign has been very excited, and a large business has been done at advancing prices, but the market closes quieter. Straits are now quoted at 124*l.* to 125*l.* cash, 123*l.* 10*s.* three months prompt, 126*l.* afloat. Banca 128*l.* to 129*l.* 10*s.* The Dutch market is firm at 77 f.

LEAD.—The market for this metal has been quiet. Good soft English 21*l.*, W. B. 23*l.*

SPELTER.—The market for this article has been very dull, and hardly any business has been done. On the spot and in Hull 18*l.*, W. H. 18*l.* 12*s.* 6*d.*

NEW YORK, *March* 5. INGOT COPPER.—Inactive at 36 to 36¼ cents per lb. for Baltimore and Bergenport, and 36¼ to 36¾ cents Lake. The recent heavy decline in gold has checked a movement that had commenced in this metal, but holders profess confidence in prices, owing to the reported shortness of stocks.

PIG-IRON.—The arrivals of Scotch pig are still very small, and prices range at 39½ to 40 dollars cash, with very small stock; 500 tons, recently arrived, are being bonded, inasmuch as the market price is not up to importation cost, said by the importers to be 41½ dollars cash. American: The companies are not offering any irons, reporting themselves to be sold up. Prices from second hands rule at No. 1 ex. 35 to 36 dollars cash; No. 2 ex. 34 to 35 dollars; No. 2 hard, 32 to 33 dollars; No. 3, grey, 30 to 32 dollars cash. The demand for foundry iron is good.

CHARCOAL PIG-IRONS.—Sales of 52½ dollars cash of Salisbury, and at 65 dollars of Sterling.

SPELTER.—Firm at 9½ to 10 cents per lb. Stocks small, and in few hands.

LEAD.—Quiet at 10 to 10¼ cents for prime brands.

TIN.—Stocks large. A very extensive speculative movement has occurred, by which prices of Banca have been advanced to 59 and 60 cents; Straits, 57 cents and 58 cents; English, 54 cents and 55 cents; but the decline in gold has eased prices to-day.

TIN PLATES.—The demand is fair, and prices are easier, in consequence of the decline in gold. IC Charcoal, 15 to 15½; terne charcoal, IC, 13 dollars; IC coke, 12 dollars; coke terne, 11 dollars for invoice lots; store lots higher. Market, owing to the condition of gold, unsteady for the time.

BERLIN, *March 21st.* IRON.—The market for this article has been quiet, and it has only been dealt in so small quantities. Iron in bars fron 3⅝ to 4 thalers. Staffordshire descriptions 5⅓ thalers.

TIN.—This article has been more in demand and closed at higher rates. Banca 43½ to 44 thalers. English 40 to 41 thalers.

LEAD.—The market for this article has been firmer. On the spot 7 thalers.

COPPER.—This article has been in good demand at higher prices. Kapunda 33½ thalers. Burra Burra 33 thalers. Demidoff 36 thalers.

HAMBURG, *March 19th.*—The market has been very quiet, and there is little of interest to report.

LEAD.—German pig-lead 13½ to 13¾ marks. English pig-lead 14½ marks; sheet-lead 15 marks.

IRON.—Scotch pig-iron, No. 1, 2⅝ marks. Iron in bars 5 to 5⅛ marks. Staffordshire descriptions 2⅞ to 6⅛.

COPPER.—This article has been in small request and prices are only nominal. Burra Burra and Kapunda 65 marks. Chili 66 marks.

TIN.—BANCA has not advanced here at the same rate as in Holland, and closes at 13½ schellings; English 12½ schellings.

AMSTERDAM, *March 21st.* TIN.—Banca is rising here, and a good business has been done. It closes at 77 florins.

ROTTERDAM, *March 20th.* TIN.—Six thousand slabs of Banca have been sold at 76 florins.

SHANGHAI, *January* 25th. LEAD.—This metal was quoted at 6–2 taels.

IRON.—Nailrod, 2-1 to 2-4 taels.

HONG KONG, *February* 13st, LEAD was in demand. Sales, 734 pigs at Hong Kong, at 7 dollars 20 cents to 7 dollars 80 cents; and about 1,000 piculs at Canton, at, for common, 8 dollars 30 cents to 8 dollars 35 cents; W. B. mark, 8 dollars 70 cents, to 8 dollars 80 cents, duty paid.

IRON.—Small sales, at about previous rates.

TIN PLATES.—100 boxes sold; quoted, 5 dollars 80 cents, to 6 dollars 10 cents.

Furnished by Von Dadelszen and North, 158, Leadenhall Street, London, E.C., 28th March, 1863.

During the present month we have to report a good average business in nearly every description of metals; whilst in tin, both English and Foreign, a very large business has been done.

IRON.—Welsh bars are quiet at *5l.* 10*s.* in Wales, and *6l.* 5*s.* here. Staffordshire in fair demand without change in price. Scotch pigs have experienced a very heavy fall, closing at very nearly the lowest, viz., 51*s.* 6*d.* cash buyers. Sellers at 51*s.* 7½*d.*

COPPER.—For both tile and ingot as well as manufactured the market has been remarkably quiet. Official prices are firmly maintained. We quote tough cake and tile 89*l.* Manufactured 96*l.* per ton. In Foreign, Burra 94*l.* 10*s.* to 95*l.* Kapunda ingots 96*l.* 10*s.* Spanish 85*l.* to 87*l.* Chili 83*l.* 10*s.*

TIN.—A very large business has been done as well in English as Foreign Straits have advanced fully 3*l.*, and Banca from 4*l.* to 4*l.* 10*s.* per ton. The Dutch market has advanced from 73*fl.* to 77*fl.*, and closes very firm with an upward tendency.

TIN PLATES are in good demand—prices nominally the same.

LEAD is quiet, 20*l.* 15*s.* to 21*l.* is asked for good soft English.

SPELTER remains the same; buyers are scarce, still 18*l.* is firmly asked for spot parcels, and 18*l.* 5*s.* with a prompt. W. H. 18*l.* 10*s.* Hull parcels 18*l.*

Metallic-Ore Markets.

London, March 30th, 1863.

TIN.—The tin standard has not altered since our last, and therefore remains at—

Superior Fine	.. £110	Superior Common	.. £106
Second Fine	.. 108	Second Common	.. 105

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard have been as follows:—

Date.	*Tons.*	*Produce.*	*Fine Copper.* Tons. cwt.	*Price per ton.*	*Standard.*
Feb. 26.	.. 2,530	.. 6¼	.. 158 3	£4 9 6	£115 13 0
Mar. 5.	.. 3,277	.. 7	.. 229 9	5 5 6	114 14 0
„ 12.	.. 2,549	.. 6⅛	.. 167 14	4 18 6	116 11 0
„ 19.	.. 5,710	.. 5⅞	.. 338 1	4 6 0	119 4 0

At the sale of the 20th the standard slightly advanced. At the sale of March 5th the advance in the standard was 2*l.* according to the *Mining Journal* but 1*l.* 10*s.* according to the *West Briton*. At the sale of the 12th the standard remained stationary. At the sale of the 19th the standard declined 1*l.* 10*s.* according to the *Mining Journal*, but only 15*s.* according to the *West Briton*.

LEAD.—Comparing this month's sales with those of last we find that prices have, on the whole, declined.

Coal Markets.

London, March 30th, 1863.

LONDON.—From the returns of the Registrar of the London Coal Exchange, of the quantity of sea-borne Coal, Culm, and Cinders, imported into London in the month of February, we learn that the total quantity was 325,879 tons, against 333,664 tons during the corresponding month of last year, showing a *decrease* of 7,785 tons.

The following are the particulars of the 325,379 tons imported during February:—

Newcastle	120,526 tons, in	322	ships
Seaham	19,628 „	75	„
Sunderland	94,926 „	224	„
Middlesbro'	6,246 „	23	„
Hartlepool	66,629 „	222	„
Blyth	3,327 „	11	„
Scotland	1,958 tons, in	7	ships
Wales	5,732 „	11	„
Yorkshire	3,776 „	30	„
Small	1,628 „	6	„
Cinders	1,503 „	7	„

The quantity of coal imported by railways and canals during the month of February was 132,354 tons, against 110,024 tons during the corresponding month last year—showing an *increase* of 22,330 tons.

On March 2nd, forty-three arrivals caused a large supply and business was inactive. The prices for the different kinds were:—best house coal 16*s.* to 17*s.*; seconds 13*s.* to 14*s.*; Hartley's 12*s.* 6*d.* to 14*s.*; manufacturers' 11*s.* to 14*s.* per ton. On the 4th, the arrivals were not great and the market was steady for all descriptions. On the 6th there were considerable arrivals, but no change in the market. On the 9th there were few arrivals and the tone of the market for house coal was slightly better, but without alteration in prices. On the 11th, thirty-two ships arrived, and the cold weather caused more activity for house coal at an advance of 3*d.* per ton. On the 13th there being very few arrivals there was a decided improvement in the market, and prices advanced from 3*d.* to 6*d.* per ton all round. On the 16th there were large arrivals, and the weather being cold, there was a brisk demand for house coal at an advance of 1*s.* per ton. On the 18th only eighteen ships arrived, and the weather continuing cold, there was a ready sale for house coal at a further improvement of 6*d.* per ton; Hartley's also advanced 6*d.* On the 20th there were very few arrivals, but the weather having become mild, the tone of business was dull, and prices of house coal and Hartley's, 3*d.* per ton lower. On the 23rd, the arrival of two hundred and thirty-nine fresh ships, and a return of fine mild weather, produced a very heavy market for house coal, and the sales wre inconsiderable, at a reduction of from 6*d.* to 1*s.* per ton in price. Hartley's were in excess, and submitted to a reduction of 6*d.* per ton. Manufacturers' quiet at previous value. Best house coal, 17*s.* to 17*s.* 6*d.*; seconds, 14*s.* 6*d.* to 15*s.* 6*d.* Hartley's, 13. 6*d.* to 14*s.* 3*d.* Manufacturers', 11*s.* 6*d.* to 14*s.* per ton.—On the 25th, forty six more ships having come forward, with a continuance of very fine mild weather, the market was still further depressed. House coals submitted to a reduction of 6*d.* per ton. In Hartley's and manufacturers' coals no alteration—On the 27th, the depression in the market for house coal was increased by the arrival of eighty one more ships, and caused a further fall of 6*d.* per ton. Hartley's and manufacturers' were also a dull sale, and barely supported last market's prices. Hetton Wallsend, 16*s.* 6*d.*; South Hetton Wallsend, 16*s.* 6*d.*; Lambton Wallsend, 16*s.*; Braddyll's Hetton Wallsend, 15*s.*; Russell's Hetton Wallsend, 14*s.* 6*d.*; Framwellgate Wallsend, 13*s.* 6*d.*; Harton Wallsend, 13*s.*; Hasting's Hartley, 14*s.*; Bute's Tanfield, 12*s.* per ton: seventy one cargoes unsold; 45 ships at sea.

General Exports of Coal.—From Messrs. J. and T. Platt's Coal Circular for December, we find that the quantity of *coal, cannel, coke, and patent fuel shipped from Liverpool* to foreign and colonial ports during the month of February was 51,949 tons, against 49,794 tons during the corresponding month of last year, showing an *increase* of 2,155 tons. The shipments coastwise during February were 7,168 tons, against 4,690 tons during the same month last year—showing an *increase* of 2,478 tons.

The oversea exports from Bristol during the month of February amounted to 477 tons, against 1,868 tons during the corresponding month last year—showing a *decrease* of 1,391 tons.

The general exports of coal during February were 485,613 tons, against 590,782 tons in the corresponding month of 1862, showing a decrease of 105,169 tons. The particulars are—From the Northern ports, 216,557 tons; Yorkshire, 16,694 tons; Liverpool, 49,574 tons; Severn ports, 174,196 tons; and Scotch, 28,592 tons. The increase was—Yorkshire, 3,765 tons; Liverpool, 1,653 tons. The decrease—Northern ports, 102,346 tons; Severn 1,301 tons; Scotch ports, 6,940 tons.—Total exports, January to February, 1859, 879,994 tons, against 1,044,037 tons in 1862, showing a decrease of 164,043 tons.

CONTRACT FOR COAL.—The Compana General de Credito, in Spain, require tenders for the supply of 4,000 tons of Coal for gas-making.

THE COAL TRADE OF THE UNITED STATES.—In referring to the progress of the coal trade of the United States, the *Railroad and Mining Register* (March 14th) states that the war has so interrupted the coal trade in certain parts of the country that it is impossible to make out a statement of proximate results for 1862. The yield in Eastern Pennsylvania was, of hard anthracite, 8,170,680 tons in 1860: 7,626,515 tons in 1861; and 7,856,168 tons in 1862; and of semi-anthracite and bituminous 579,564 tons in 1860; 646,305 tons in 1861; and 809,063 tons in 1862. The produce of bituminous coal in Maryland was 666,572 tons in 1860; 269,674 tons in 1861; and 317,634 tons in 1862. The Broad Top semi-bituminous district produced 272,625 tons in 1861; and 334,135 tons in 1862. The aggregate yield of the entire States may, however, be judged of from the above figures, since the corrected return for 1860 shows that of bituminous coal Pennsylvania produced 45½ per cent. of the quantity, and 37¼ per cent. of the value of the whole; and of all kinds of coal Pennsylvania produced 75 per cent. of the whole value.

London Share Market.

London, March 28th, 1863.

THERE has been, on the whole, an active market during the month, but with less excitement than for some months past. There has been no heavy "market operations" except in North Roskear, which ended in a collapse. Copper mines have been generally flatter, and tin mines in most favour.

A large amount of attention has been absorbed by *East Caradon* shares, which have steadily declined all through the month, the fall at one time reaching 10*l.* per share, or upwards of 60,000*l.* for the mine. They opened at 47*l.*-48*l.*, but by the 12th were quoted at 41*l.* sellers. They continued flat at prices ranging from 41*l.* to 44*l.* until the 19th, when they had fallen to 40*l.*-41*l.*, at which price they remained until the 24th, when they again commenced declining, reaching their lowest point (38*l.* sellers) on the 26th. On the 27th, they rallied to 40*l.*-41*l.*, but again closed flatter, at 40*l.*-40½*l.* *West Caradon*, 32*l.*-34*l.* *South Caradon*, 400*l.*-410*l.* *Marke Valley*, had declined 1*l.* per share from 8¼*l.*-8⅜*l.* to 7½*l.* to 7¾*l.* *Gonamena*, 2¼*l.*-2¾*l.* *South Caradon Wheal Hooper*, 17*s.*-19*s.*

The transactions in *North Roskear* shares have been most extensive, but principally as "market operations." The opening price was 57*l.*-59*l.*, at which they were largely dealt in. They continued to advance until the 6th, when they were strong at 61½*l.*-62½*l.* They fluctuated between 60*l.* and 62*l.* until the 20th, when they declined to 56*l.*-58*l.* They continued to recede until the 23rd, when they were flat at 50*l.*-52*l.* They recovered again to 53*l.*-54*l.*, but close at 51*l.*-52*l.* The operations in this mine have been rather interesting regarded as a battle between the Bulls and Bears, but in consequence of some of the former party not holding together, the Bears have had decidedly the best of it.

North Crofty shares have advanced about 1*l.* per share on our last quotation. They opened at 4⅜*l.*-4⅝*l.*, at which they remained with little variation until towards the end of the month, when they became in demand and advanced to 5⅜*l.*-5⅝*l.*, closing 5¼*l.*-5½*l.* *South Crofty*, 31*l.*-32*l.*

A large amount of business has been transacted in *Tincroft* shares, which at one time had advanced 4*l.* per share on the closing prices of last

month. They opened at 19*l.*-20*l.*, at which they continued with little variation until the 16th, when they became in great demand at 21*l.*, buyers. By the 21st they had reached 22½*l.*-23½*l.*, and on the 24th they were quoted 23*l.*-24*l.* They continued at this price until the 25th, since which they have slightly declined, closing 22*l.*-22½*l.* *Illogan Consols* have advanced to 30*s.*-32*s.* 6*d.* *Cook's Kitchen* shares have slightly declined during the month, although a good deal of business has been done in them. They opened at 30*l.*-31½*l.*, but gradually receded in price until the 13th, when they were 26½*l.*-27*l.* On the 16th they recovered a little, and were in demand at 27*l.*-28*l.* On the 19th they were 28*l.*-29*l.*, from which they advanced to 29*l.*-30*l.*, but again slightly receded, closing at 28*l.*-29*l.* *Condurrow*, 90*l.*-95*l.* *Dolcoath*, 570*l.*-590*l.*

There have been very extensive dealings in *Great Wheal Fortune* shares at advancing prices. They opened at 33½*l.*-34½*l.*, and gradually advanced without interruption until the 18th, when they were 37½*l.*-38½*l.*, at which price they have remained tolerably steady, closing 37*l.*-38*l.* *Wendron Consols* shares have been in great demand all through the month, and have advanced 5*l.* per share. They opened at 11½*l.*-12½*l.* On the 9th they were in demand at 13¼*l.*-14*l.* They continued in active request until the 19th, when they were 15*l.*-16*l.*, at which price they remained until the end of the month, closing at 16*l.*-17*l.* *Calvadnack* shares have advanced nearly 3*l.* per share. They opened at 7¼*l.*-7¾*l.* On the 6th they had advanced to 9½*l.*-10*l.*, and have continued at this price with little variation, closing at 9¾*l.*-10*l.* *Wheal Grylls*, 33*l.*-34*l.*

Wheal Seton shares have been in good demand at fluctuating prices, having at one time declined 7*l.* per share, and again advanced 5*l.* per share on last month's closing prices. They opened at 245*l.*-250*l.*, but gradually declined until the 5th, when they reached the lowest price, 232*l.*-237½*l.* On the 9th they had advanced to 250*l.*-252½*l.*, at which there was an active business. On the 18th they were 250*l.*-255*l.*, between which price and 247½*l.*-250*l.* they have since fluctuated, closing 247½*l.*-250*l.* *West Seton*, 270*l.*-280*l.*

A fair amount of business has been done in *Wheal Ludcott*, but prices have on the whole been lower than last month. Shares opened at 6½*l.*-7*l.*, and on the 9th they advanced to 7½*l.*-8*l.*, being scarce for delivery. After the account on the 19th, they receded to the opening price, at which they close. *Wheal Mary Ann* shares have slightly receded. They opened at 16*l.*-17*l.*, and close at 15½*l.*-16*l.* *Cargoll*, 44*l.*-45*l.* *Herodsfoot*, 47*l.*-47½*l.* *Wheal Trelawny*, 17*l.*-18*l.*

There has been a good business in *East Basset* shares, but prices have declined. Shares opened at 90*l.*-95*l.* On the 4th they were very flat at 77½*l.*-82½*l.*, but they rallied again, and on the 17th there were buyers at 84*l.* On the 24th, they had reached 87½*l.*-90*l.*, but after that date they again receded to 76*l.*-78*l.*, but close better at 80*l.*-81*l.* In the beginning of the month *Copper Hill* attracted a great deal of attention, and the shares were largely dealt in at 95*l.*-100*l.* They continued to maintain this price until the 12th, when they began to recede, and, after fluctuating between 82½*l.*-87½*l.* and 87½*l.*-92½*l.* they close 85*l.*-87½*l.* *Wheal Basset*, 80*l.*-85*l.* *Wheal Buller*, 60*l.*-65*l.* *North Basset*, 4½*l.*-4¾*l.*

Drakewalls shares have altered little in price, but the general tone of the market for them has been flat. They opened at 2¼*l.*-2½*l.* and close at 2*l.*-2½*l.* *East Russell* shares have declined. They opened at 5*l.*-5½*l.* and close at 4½*l.*-4¾*l.* *Wheal Crebor* shares have advanced to 29*s.*-30*s.* *Wheal Edward* shares have declined 1*l.*, from 3*l.*-3½*l.* to 2*l.*-2½*l.* *Kelly Bray*, 12*s.* 6*d.*-15*s.*

Very little business has been done in *Wheal Harriett*, and prices have declined, closing at 2⅞*l.*-3⅛*l.* *Stray Park*, 39*l.*-39½*l.* *Wheal Grenville*, 5¼*l.*-5¾*l.* *East Grenville*, 48*s.*-50*s.*

East Carn Brea shares have been flat all through the month, and at one time had declined nearly 2*l.* per share, but again rallied a little. They opened at 10*l.*-10¼*l.*, and close at 9⅞*l.*-9⅞*l.* *South Frances* shares have advanced from 85*l.*-90*l.* to 90*l.*-95*l.* ex div. *South Tolgus* share have declined from 66*l.*-68*l.* to 58*l.*-60*l.*

Providence shares have been in fair demand at 42*l.*-44*l.* *Wheal Margaret* shares have again declined. They opened at 36*l.*-38*l.*, and close at 34*l.*-35*l.* *Rosewall Hill and Ransom United*, 3*l.*-3¼*l.*

Pendeen Consols shares have advanced during the month. They opened at 6*l.*-6¼*l.*, and close at 7*l.*-7¼*l.* *East Rosewarne*, 3¼*l.*-3⅜*l.* *Wheal Kitty* (St. Agnes) 4⅜*l.*-4⅞*l.* *North Downs*, 2⅜*l.*-2⅞*l.*

Transactions are also reported in the following mines:—*Clifford Amalgamated*, 20*l.*-21*l.*; *West Tolgus*, 67*l.*-69*l.*; *Caradon United*, 2*l.*-2½*l.*; *Glasgow Caradon Consols*, 3½*l.*-3¾*l.* *South Carn Brea*, 3¾*l.*-4*l.* *North Treskerby*, 3⅜*l.*-3⅞*l.* *South Phœnix*, 1¼*l.*-2*l.* *Tolcarne*, 3*l.*-3½*l.* *North Dolcoath*, 2¼*l.*-2⅜*l.* *Grambler and St. Aubyn*, 15*l.*-17*l.* *Great South Tolgus*, 5⅜*l.*-6*l.* *Wheal Arthur*, 7*s.* 6*d.*-10*s.* *Wheal Union*, 4⅞*l.*-5⅛*l.* *Wheal Uny*, 6¾*l.*-7*l.* *Basset and Grylls*, 27½*l.*-28*l.*

In Welsh mines, *Longrake* closes at 19*l.*-20*l.*; and *Vigra and Clogau*, at 25*l.*-27*l.*

In colonial and foreign mines business has been done at the following prices:—*Bon Accord*, ¼. *Cape Copper*, 2½*l.*-2⅝*l.* *Capula*, ½. *Don Pedro North Del Rey*, ⅜-⅞. *Dun Mountain*, ½. *East Del Rey*, 1½*l.* *Fortuna*, 5⅜*l.* *Great Northern Copper of South Australia*, ½. *Lusitanian*, 2*l.* *Port Phillip*, 1⅜*l.*-1½*l.* *Santa Barbara*, ½-⅝. *St. John Del Rey*, 56½*l.*-57½*l.* *United Mexican*, 5¾*l.*-5⅞*l.* *Yudanamutana*, 4*l.*-4⅛*l.*

New undertakings have been quoted at the following prices:—*West Clogau*, ½ dis.-par. *St. David's Gold*, ⅜-½ dis. *Dolfrwynog* ⅛ dis.-⅛ prem. *East Cambrian*, par-¼ prem. *Anglo Prussian*, ¾-1*l.* prem. *Nova Scotia Gold*, ⅜-½ dis. *Alamillos*, ⅜-⅝ prem. *Vallanzasca*, ¼-½ prem. *Great Devon and Bedford* ⅛-⅜ prem.

Provincial Share Markets.

DUBLIN.—The following is condensed from the *Mining Journal:*—The market has been dull all through the month and prices have somewhat declined. *Wicklow Copper* shares opened at 41*l.* 7*s.* 6*d.* to 42*l.*, at which they were largely dealt in. They were firmly held till towards the end of the month when they receded in price and close at 40*l.* *General Mining Company for Ireland* shares have also receded in price. They opened at 5*l.* 5*s.*, at which they were flat. They close at 5*l.* with nothing doing. *Carysfort* shares opened at 21*s.* 6*d.*, at which they were in fair request, and close at 21*s.* *Connorree* shares were dealt in early in the month at 20*s.* 6*d.*; but some shares being pressed on the market they became weaker and close at 18*s.* 6*d.* to 19*s.* *Mining Company of Ireland* shares have slightly declined in price. They opened at 5*l.* 15*s.* and close at 5*l.* 12*s.* 6*d.*, at which they have been freely dealt in.

CORNWALL.—The following is condensed from the *West Briton:*—The mining market has been active through the month, although in some instances prices have not been maintained. *Wheal Reeth* shares have declined during the month. They opened at 40*l.*-42*l.* and close at 37½*l.*-40*l.* *South Crofty* shares have recovered last month's decline. They opened at 25*l.*-26*l.*, and close at 30*l.*-31*l.* *Emily Henrietta* 9½*l.*-10*l.* *Crane* 15*l.*-17*l.* *Wheal Agar* 4¾*l.*-5¼*l.* *South Seton* 28*l.*-30*l.*

Tabular Abstract of Mining Accounts for the Month.

Date of Meeting.	Name of Mine, and Number of Shares.	Balances. Debit.	Balances. Credit.	Calls. Per Share.	Calls. Total.	Dividends. Per Share.	Dividends. Total.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
	CORNISH AND DEVON MINES.						
. 19	Falmouth and Sperries (2,000)	495 16 8	—	0 5 0	500 0 0	—	—
20	Wheal Owles (80)	—	2,285 0 0	—	—	7 10 0	600 0 0
23	East Pool (128)	—	799 8 8	—	—	5 0 0	640 0 0
23	South Crofty (937)	1,837 19 10	—	1 10 0	1,405 10 0	—	—
24	Great Work (119)	1,012 0 2	—	—	—	—	—
24	East Carn Brea (6,000)	477 7 8	—	0 4 0	1,200 0 0	—	—
24	Pendeen Consols (5,000)	—	1,461 18 9	—	—	—	—
24	Wheal Union (6,000)	—	438 0 0	—	—	—	—
24	Bedford Consols (4,000)	—	13 4 5	0 1 0	200 0 0	—	—
24	North Levant (2,000)	597 6 10	—	0 5 0	500 0 0	—	—
24	Rosewarne Consols (4,026)	241 16 10	—	0 5 0	1,006 10 0	—	—
24	Buller and Basset (6,380)	654 19 0	—	0 5 0	1,595 0 0	—	—
24	Treloweth (5,000)	1,961 9 0	—	0 8 0	2,000 0 0	—	—
24	Fowey Consols (4,940)	—	1,340 9 0	—	—	—	—
24	Wheal Prosper (970)	1,414 3 11	—	1 15 0	1,697 10 0	—	—
25	Providence (1,120)	—	1,526 9 7	—	—	1 0 0	1,120 0 0
25	Wheal Hearle (1,024)	261 0 0	—	0 5 0	256 0 0	—	—
25	Boscaswell (1,248)	—	211 6 6	—	—	—	—
26	Scorrier Consols (2,000)	375 5 2	—	0 6 0	600 0 0	—	—
26	East Russell (4,000)	—	158 12 3	0 2 6	500 0 0	—	—
r. 2	East Falmouth (2,048)	—	1,340 0 9	—	—	—	—
2	Wheal Damsel (512)	434 12 1	—	1 10 0	768 0 0	—	—
3	Grambler and St. Aubyn (486)	212 13 3	—	1 0 0	486 0 0	—	—
3	Hawkmoor (7,219)	—	—	0 1 6	541 8 6	—	—
3	South Crenver (2,283)	155 11 10	—	0 5 0	570 15 0	—	—
4	Yarner (3,097)	830 19 9	—	0 2 6	387 2 6	—	—
4	Gawton (4,000)	—	231 0 0	—	—	—	—
4	Stray Park (920)	1,116 8 10	—	1 5 0	1,150 0 0	—	—
4	West Sharp Tor (256)	415 11 11	—	3 0 0	768 0 0	—	—
4	Trelyon Consols (572)	610 1 3	—	0 10 0	286 0 0	—	—
5	North Dolcoath (5,000)	123 15 6	—	0 2 6	625 0 0	—	—
6	Wheal Tremayne (1,022)	281 15 1	—	—	—	—	—
7	Devon Wheal Buller (4,566)	393 11 0	—	—	—	—	—
11	Caradon Consols (914)	133 10 2	—	0 15 0	685 10 0	—	—
11	Leeds and St. Aubyn (1,019)	1,120 2 11	—	1 2 0	1,120 8 0	—	—
12	North Roskear (700)	—	187 0 0	—	—	—	—
13	East Agar (1,190)	1,031 11 8	—	1 10 0	1,785 0 0	—	—
13	Crane (861)	749 7 9	—	1 0 0	861 0 0	—	—
16	West Condurrow (1,218)	550 4 5	—	0 9 2	558 5 0	—	—
16	Curtis (1,000)	—	—	1 0 0	1,000 0 0	—	—
17	Carnyorth (2,048)	729 15 3	—	—	—	—	—
17	Wheal Mary Ann (1,024)	—	2,639 1 11	—	—	0 10 0	512 0 0
18	Great Wheal Vor (5,908)	—	2,991 0 0	—	—	0 5 0	1,447 0 0
18	Caradon Vale (10,000)	—	4,452 16 3	—	—	—	—
18	Wheal Uny (4,096)	153 3 11	—	—	—	—	—
19	Wheal Edward (4,096)	244 12 10	—	0 2 6	512 0 0	—	—
20	Maudlin Mines (6,000	475 16 6	—	0 3 0	900 0	—	—
	WELSH & IRISH MINES.						
eb. 6	Minera (1,800)	—	—	—	—	8 0 0	14,400 0 0
7	Hibernian Mine (1,000)	—	—	—	—	0 15 0	750 0 0
25	Penralt (6,000)	184 4 8	—	0 2 0	600 0 0	—	—
lar. 2	Cardigan Consols (10,000)	96 0 0	—	—	—	—	—
16	North Laxey (6,000)	98 5 7	—	—	—	—	—
	FOREIGN MINES.						
eb. 25	Santa Barbara (60,000)	—	12,261 15 9½	—	—	—	—
27	East Kongsberg (30,000)	—	367 18 3	—	—	—	—
lar. 12	Linares (15,000)	—	—	—	—	0 5 0	3,750 0 0
12	Fortuna (25,000)	—	—	—	—	0 3 4	4,166 13 4

Prices Current of Metals.

From Messrs. JAMES and SHAKSPEARE'S, 10, Austin Friars, E.C. 28*th March*.

						Per Ton.			
IRON	Bars	(Welch)	in Wales	£5	10	0	@	£5	15 0
	"	"	" Liverpool	6	2	6	"	6	7 6
	"	"	" London	6	10	0	"	6	12 6
	Nail Rods	"	" Wales		——		"	6	5 0
	"	(Staffordshire)	" Liverpool	6	12	6	"	7	0 0
	"	"	" London	7	0	0	"	7	10 0
	Hoops	"	" Liverpool	8	0	0	"	8	2 6
	"	"	" London	8	7	6	"	8	10 0
	Sheets	"	" Liverpool	8	12	6	"	9	5 0
	"	"	" London	9	5	0	"	9	10 0
	Bars	"	" Liverpool	6	15	0	"	7	0 0
	"	"	" London	7	7	6	"	7	10 0
	Scotch Pig (No. 1. g.m.b.)		the Clyde	2	11	6	"	2	12 0
	Rails		in Wales	5	10	0	"	5	15 0
	Swedish—Hammered—large sizes				——		"	11	5 0
	"	"	Indian assortments		——		"	11	10 0
STEEL	Hammered—faggot				——		"	17	0 0
	"		in kegs ¼ and ⅛ in.		——		"	16	0 0
COPPER	Burra and P.C.C.				——		"	95	0 0
Australian	Kapunda			95	10	0	"	96	10 0
	Wallaroo			94	10	0	"	95	10 0
American	Baltimore				——		"	96	0 0
	Lake Superior				——		"	96	0 0
	Spanish Cake			85	0	0	"	87	0 0
	Chili and other Slab, for 96 per cent. pure Copper			81	10	0	"	82	10 0
English	Tough Cake and Ingot and Tile				——		"	89	0 0
	Best selected Ingot				——		"	92	0 0
	Sheets, Sheathing and Rod				——		"	96	0 0
	Flat Bottoms				——		"	101	0 0
						Per lb.			
YELLOW METAL	Sheets					8*d*.		8¼*d*.	
	Sheathing and Rod					8¼*d*.		8½*d*.	
						Per Cwt.			
TIN	Common Blocks and Ingots				——		"	119*s*.	
English	"	Bars (in barrels)			——		"	120*s*.	
	Refined				——		"	124*s*.	
Foreign	Straits, Fine			124*s*.			"	125*s*. 6*d*.	
	Banca			129*s*.			"	130*s*.	
						Per Box.			
TIN PLATES at Liverpool 6*d*. Less	Charcoal	IC, best		28*s*. 6*d*.			"	29*s*. 6*d*.	
	"	IX "		34*s*. 6*d*.			"	35*s*. 6*d*.	
	Coke	IC		22*s*. 6*d*.			"	24*s*. 6*d*.	
	"	IX		28*s*. 6*d*.			"	30*s*. 6*d*.	
						Per Ton.			
LEAD	Sheet			21	5	0	"	£21	10 0
English	Pig—W.B.			22	15	0	"	23	0 0
	"	Other good brands		21	0	0	"	21	7 6
	"	German and Spanish, soft		20	7	6	"	20	10 0
English	Red				——		"	21	15 0
	Shot				——		"	23	10 0
	Dry White				——		"	26	10 0
SPELTER	(Silesian) in Cakes			18	0	0	"	18	5 0
ZINC	(Sheet) No. 9 and upwards			23	5	0	"	23	10 0
						Per Bottle.			
QUICKSILVER	(in bottles containing 75lbs. each)				——		"	7	0 0
						Per Ton.			
REGULUS OF ANTIMONY	French Star			40	0	0	"	41	0 0

Copper Ores.

Sampled Feb. 11, and sold at the Tabb's Hotel, Redruth Feb. 26

Mines.	Tons.	Purchasers.	Price. £ s. d.
South Caradon	103	9	£4 10 0
	94	7	4 14 0
	85	3, 7	7 8 6
	75	6	6 8 6
	52	3	15 13 0
	50	1	18 5 6
	31	3	5 9 6
Great Wheal Busy	68	10	1 17 6
	66	7	2 17 6
	57	7	2 4 6
	45	9	3 2 0
	40	1	1 15 6
	36	6	2 8 6
	33	1	2 3 6
	32	7, 13	3 1 6
	30	7	2 12 6
	16	5, 7	4 1 0
West Damsel	80	2	0 17 0
	79	13	3 13 6
	78	6	3 16 6
	63	6, 13	4 2 0
	51	4, 6	4 18 0
	50	2	3 12 0
Fowey Consols	80	9	4 12 6
	79	5, 7	4 16 0
Fowey Consols	77	1	£5 12 6
	50	1, 5	5 2 6
Clifford Amalgamated	92	5	3 12 6
	40	10	1 4 0
	38	10	0 18 6
	33	5	3 9 6
	24	5	3 11 6
Tywarnhaile	75	12	1 13 6
	58	7	5 9 6
	54	12	1 11 6
	33	7	2 19 6
Craddock Moor	63	11	6 12 6
	60	9	4 14 0
	22	10	2 19 6
	21	7	4 6 0
Great Brigan	57	6	5 11 6
	53	5, 12	3 8 0
Great North Downs	48	3	5 9 6
	46	3, 8	4 1 6
North Grambler	50	3	4 12 0
Falmouth & Sperries	24	2, 5	2 15 6
North Hallenbeagle	18	3	3 18 0
Grambler & St. Aubyn	12	7	5 12 6
Cook's Ore	5	7	7 14 0
Pembroke	3	12	2 19 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount. £ s. d.
South Caradon	491	£3,964 4 0
Great Wheal Busy	423	1,055 12 0
West Damsel	401	1,344 17 6
Fowey Consols	286	1,438 11 6
Clifford Amalgamated	227	617 2 6
Tywarnhaile	220	626 8 0
Craddock Moor	166	855 2 6
Great Brigan	110	497 19 6
Great North Downs	94	£450 5 0
North Grambler	50	230 0 0
Falmouth and Sperries	24	66 12 0
North Hallenbeagle	18	70 13 0
Grambler and St. Aubyn	12	67 10 0
Cook's Ore	5	38 10 0
Pembroke	3	8 18 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount. £ s. d.
1 Vivian and Sons	237	£1,651 1 6
2 Freeman and Co.	130	248 0 0
3 Grenfell and Sons	265	1,959 19 6
4 Crown Copper Co.	25½	124 19 0
5 Sims, Willyams & Co.	260	1,007 10 0
6 Williams, Foster & Co.	303	1,439 8 0
7 Mason and Elkington	482½	2,039 12 6
8 Bankart and Sons	23	93 14 6
9 Copper Miners' Co.	288	£1,296 4 0
10 Charles Lambert	168	276 2 0
11 Newton, Keates & Co.	63	417 7 6
12 Sweetland, Tuttle & Co.	158½	309 14 0
13 Neath Copper Co.	126½	468 3 6
Total	2530	£11,332 6 0

Average Produce, 6¼.
Quantity of Fine Copper, 158 tons 3 cwts.

Average Standard £115 13 0
Average Price per ton 4 9 6

Sundry Copper Ore Sales.

Date.	Mines.		Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Feb. 20.	Pary's Mines	Lot 1	270	5 1 6	Newton, Keates & Co., Mona Co.	
	,,	2	44	10 17 6	ditto	2049 5 6
	,,	3	22	6 3 6	C. Lambert, Mona Co.	
	,,	4	24	5 10 6	ditto	
Mar. 19.	,,	Lot 1	320	6 7 6	Mona Co. and J. Bibby, Sons & Co.	2040 0 0

Blende Sales.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
March 6.	Minera	48	2 15 6	A. Courage & Co.	
	,,	31	3 1 6	ditto	323 12 0
	,,	23	2 0 0	W. Kenrick	
	,,	13	3 15 6	A. Courage & Co.	

Copper Ores.

Sampled Feb. 18, and sold at Tabb's Hotel, Redruth, Mar. 5.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	101	1	£5 9 6
	100	6	5 18 6
	90	6, 8	6 0 6
	89	1	5 17 6
	80	12	3 0 6
	69	1	5 10 6
	65	13	6 7 6
	60	2, 9	3 14 6
	54	9	3 11 0
	40	1	3 7 6
	39	8	4 3 0
	23	5	4 6 6
West Seton	85	3	5 18 0
	73	4, 6	7 9 0
	63	10	2 9 6
	58	3, 5	4 0 0
	57	2	6 17 6
	54	7	2 16 0
	50	7, 9	2 11 6
	48	3	4 12 6
	36	3	4 10 6
	33	5	7 18 6
	23	12	6 10 6
South Tolgus	64	5	6 19 0
	52	5	7 12 0
	50	2	5 6 0
	49	10	3 3 0
	47	13	8 16 0
East Pool	86	9	4 3 0
	76	5	4 16 6
	67	6, 7	4 17 6
Wheal Seton	5	5	2 11 0
(Pendarves)	82	6	5 17 6
	61	4, 6, 9	5 0 6
	43	9	4 4 0

Mines.	Tons.	Purchasers.	Price.
Wheal Seton	15	3	£13 6 6
	10	9	1 9 6
South Frances	80	4, 6	5 1 6
	53	5	7 5 0
	32	5	7 14 0
	22	5	7 5 0
Tolcarne	48	7	3 9 6
	45	1	4 3 6
	44	12	1 16 6
	41	1	6 8 6
North Roskear (Enys.)	44	1	8 18 6
	35	8	2 8 0
	28	6	5 15 6
(Pendarves)	42	7	3 18 0
(Basset)	21	7	4 7 0
Wheal Basset	66	8	5 12 6
	65	7	6 6 0
	25	7	6 7 6
North Crofty	76	10	1 3 0
	46	3	6 7 6
East Basset	47	7	3 14 0
	34	8	5 18 6
	19	7	11 12 6
West Stray Park	60	6, 13	8 7 6
	36	6	5 17 6
Wheal Harriett	26	7	3 10 0
	24	7	6 16 6
Bampfylde	42	1, 5	13 15 6
Tresavean	22	7	1 19 6
	10	1, 5	1 18 6
South Basset	21	12	2 12 6
Crane	17	1, 5	8 18 6
	1	1	3 16 6
Emily Henrietta	10	3	5 7 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amagamated	810	£4,059 14 6
West Seton	580	2,762 14 0
South Tolgus	262	1,672 19 0
East Pool	227	1,040 9 6
Wheal Seton	216	1,196 5 0
South Frances	187	1,196 3 0
Tolcarne	178	698 8 0
North Roskear	170	893 11 0
Wheal Basset	156	940 2 6

	Tons.	Amount.
North Crofty	122	£380 13 0
East Basset	100	596 4 6
West Stray Park	96	714 0 0
Wheal Harriet	50	354 4 0
Bampfylde	42	578 11 0
Tresavean	32	62 14 0
South Basset	21	55 2 6
Crane	18	155 11 0
Emily Henrietta	10	53 10 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	464½	£2,814 13 3
2 Freeman and Co.	137	768 12 6
3 Grenfell and Sons	269	1,548 2 6
4 Crown Copper Co.	96½	577 2 0
5 Sims, Willyams, & Co.	423½	2,861 7 3
6 Williams, Foster & Co.	450½	1,705 7 3
7 Mason and Elkington	450½	2,057 5 3
8 Bankart and Sons	219	1,082 13 6

	Tons.	Amount.
9 Copper Miners' Co.	268½	£1,022 5 6
10 Charles Lambert	188	397 13 6
11 Newton, Keates & Co.		
12 Sweetland, Tuttle & Co.	168	389 10 0
13 Neath Copper Co.	142	1,079 4 6
Total	3277	£17,310 16 6

Average Produce, 7.
Quantity of Fine Copper, 229 tons 9 cwts.

Average Standard £114 14 0
Average Price per ton 5 5 6

Copper Ores.

Sampled Feb. 25, and sold at Tabb's Hotel, Redruth, March 12.

Mines.	Tons.	Purchasers.	Price.
Basset	75	1	£6 13 0
	70	6, 9	3 14 0
	58	9	4 0 0
	56	1	8 17 6
	52	9	4 11 6
	45	3	9 18 6
	43	9	3 16 0
	36	7	4 4 0
	33	2	6 7 0
d Consols	52	7	4 0 0
	50	10	1 2 6
	49	7	4 1 0
	47	10	3 1 6
	46	8	3 15 6
	45	8, 10	2 17 0
	26	10	0 10 0
	20	2, 5	4 11 6
Carn Brea	63	3	4 19 6
	61	4, 6	7 0 0
	53	4, 6	4 9 6
	32	3	4 13 6
	41	13	6 9 6
	33	2	3 12 0
	15	11	3 11 0
Consols	76	1	8 9 6
	68	9	5 3 0
	66	5	5 4 0
al Margery	56	5	6 18 0
	47	10	2 2 0
	43	10	2 4 0
	8	12	7 10 0
dden	47	2	3 14 6
	32	11	2 12 6

Mines.	Tons.	Purchasers.	Price.
Tolvadden	31	8	£3 4 6
	29	7	5 10 0
	3	1	15 0 0
Copper Hill	48	12	2 1 6
	47	12	1 14 6
	46	7	6 17 6
Prosper United	100	5	4 2 6
	19	5	1 13 0
East Rosewarne	38	7	6 14 6
	34	7	13 18 0
	26	3	9 7 0
	13	11	2 17 0
Wheal Uny	46	3	7 10 9
	41	11	6 9 0
Treworlis	33	1, 5	2 7 6
	21	1, 5	4 11 6
	13	1, 5	1 6 0
Wheal Buller	31	4, 6	7 17 6
	30	8	3 11 6
South Crenver	46	8	2 1 0
	15	11	6 9 0
North Basset	24	12	1 11 6
	21	1	5 3 6
	15	1	6 12 0
Wheal Anna	56	2, 13	5 11 0
Wheal Agar	38	8	5 0 6
Charlotte United	26	4, 6	4 11 0
Nanjiles	26	5	3 19 0
West Trevelyan	22	4, 6, 13	7 0 0
South Carn Brea	17	7	2 19 0
Great Work	16	1, 6	8 4 6
South Dolcoath	14	12	2 1 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Basset	468	£2,695 8 6
d Consols	335	1,013 12 6
Carn Brea	318	1,658 4 6
Consols	210	1,337 10 0
al Margery	154	639 14 0
dden	142	563 11 0
er Hill	141	496 18 6
per United	119	443 17 0
Rosewarne	111	1,008 6 0
al Uny	87	609 9 0
orlis	67	191 7 0
Wheal Buller	61	£351 7 6
South Crenver	61	191 1 0
North Basset	60	245 9 6
Wheal Anna	56	310 16 0
Wheal Agar	38	190 19 0
Charlotte United	26	118 6 0
Nangiles	26	102 14 0
West Trevelyan	22	154 0 0
South Carn Brea	17	50 3 0
Great Work	16	131 12 0
South Dolcoath	14	28 14 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
rian and Sons	287½	£2,054 0 0
eman and Co.	151	704 11 6
enfell and Sons	232	1,591 5 0
wn Copper Co.	92 5-6	564 12 8
s, Willyams & Co.	318½	1,483 7 6
lliams, Foster & Co.	127 5-6	694 2 8
son and Elkington	301	1,811 14 0
kart and Sons	213½	730 5 0
9 Copper Miners' Co.	256	1,113 0 0
10 Charles Lambert	235½	471 4 0
11 Newton, Keates & Co.	84	451 10 0
12 Sweetland, Tuttle & Co.	173	391 3 6
13 Neath Copper Co.	76½	472 4 2
Total	2549	£12,533 0 0

ge Produce, 6¾.
lity of Fine Copper, 167 tons, 14 cwt.

Average Standard £116 11 0
Average Price per ton 4 18 6

Copper Ores.

Sampled March 4, and sold at the Royal Hotel, Truro, March 19.

Mines.	Tons.	Purchasers.	Price.
Devon Great Consols...	137	11	£4 6 6
	125	7, 9	4 12 0
	123	7	4 12 6
	122	1, 3	4 10 6
	120	9	5 1 0
	118	3, 5	4 19 0
	115	7	4 10 6
	113	2	4 17 0
	110	6, 9	5 0 0
	109	1	3 1 0
	96	1	4 15 6
	95	8	4 16 0
	93	1, 6	8 17 6
	91	5	4 16 0
	84	1, 3, 6	9 6 0
	80	12	3 15 6
	79	3	9 2 0
	76	6	4 15 0
	72	5	3 4 0
	64	10	2 2 0
	30	12	3 11 6
	19	12	3 5 6
East Caradon	90	1	4 4 6
	85	5	4 4 0
	80	12	4 1 6
	75	1	3 18 0
	65	5	5 11 0
	60	5	6 3 6
	50	1, 5	14 6 6
Phœnix Mines	101	10	2 1 6
	92	10	2 7 6
	73	10	1 17 0
	69	7	2 16 0
	67	3	5 1 6
	50	10, 12	1 14 6
	48	2, 8	5 15 6
Marke Valley	89	1	3 18 6
	87	9	4 4 0
	80	12	2 16 6
	74	1	1 11 6
	60	6, 12	2 19 6

Mines.	Tons.	Purchasers.	Price.
Marke Valley	30	12	£2 1 0
Hingston Down	80	8	2 11 6
	71	8	3 3 6
	70	13	4 6 6
	67	5	2 12 0
	60	6, 7, 10	1 19 6
	57	9	5 15 0
New Wheal Martha ...	78	1, 5	1 1 6
	58	1, 5	0 17 6
	44	1, 5	2 14 6
	36	1, 5	1 3 6
	35	1, 5	3 1 6
East Russell	76	8	4 1 6
	45	6	7 0 0
	43	9	3 2 0
	40	8	2 8 0
	18	1	4 13 6
Bedford United	118	3	4 18 6
	91	2, 13	3 13 0
Holmbush	57	6	10 19 0
	50	6	10 5 6
	43	7	3 14 0
	41	10	3 2 6
Wheal Edward	72	3	4 10 0
	57	9	3 13 6
	49	5, 10	1 12 6
South Bedford.....	100	2, 8, 13	3 15 6
	74	12	0 13 6
Kelly Bray	87	7	5 9 0
	41	1	1 13 6
	39	6	3 16 6
Wheal Emma	51	1	2 8 6
	48	5	5 2 6
	41	1, 3	2 16 0
Wheal Friendship	76	9, 10	2 13 0
	54	1, 6	11 2 6
Brookwood	57	1, 3	3 7 0
	24	8	8 0 0
Wheal Vyvyan	23	1	1 18 6
	17	1	9 8 0
Fursdon	26	13	3 10 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols...	2,071	£10,303 7 6
East Caradon	505	2,803 5 0
Phœnix Mines.....	500	1,459 16 0
Marke Valley	420	1,297 5 6
Hingston Down	405	1,357 19 6
New Wheal Martha ...	251	404 8 6
East Russell	222	938 3 0
Bedford United	209	913 6 0
Holmbush.....	191	1,425 2 6
Wheal Edward	178	£613 2 0
South Bedford	174	427 9 0
Kelly Bray	167	692 0 0
Wheal Emma	140	484 9 6
Wheal Friendship	130	802 3 0
Brookwood	81	382 19 0
Wheal Vyvyan	40	204 1 6
Fursdon	26	91 13 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	990¼	£4,206 10 6
2 Freeman and Co.	215 5-6	978 11 2
3 Grenfell and Sons	533	2,945 8 6
4 Crown Copper Co.....	—	—
5 Sims, Willyams & Co. ...	722	3,071 4 0
6 Williams, Foster, & Co....	473½	3,340 5 9
7 Mason and Elkington ...	519½	2,242 14 0
8 Bankart and Sons	443½	1,749 11 2
9 Copper Miners' Co.	519½	£2,305 2 6
10 Charles Lambert	533	1,215 0 3
11 Newton, Keates & Co....	137	592 10 6
12 Sweetland, Tuttle & Co.	448	1,267 6 0
13 Neath Copper Co.	174 5-6	686 6 2
Total.....	5710	£24,600 10 6

Average Produce, 5¾.
Quantity of Fine Copper, 338 tons 1 cwt.

Average standard £119 4 0
Average Price per ton 4 6 0

Copper Ores.

Sampled Feb. 28, and sold at Swansea, March 17.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Cuba	100	10⅜	7	£8	1	0
	95	10½	7	8	2	0
	8	67	10	50	7	6
	90	10¼	1	8	0	6
	86	9¾	3	8	0	6
	85	10⅛	6	8	4	0
	82	10¼	3, 7	7	18	0
	77	19½	5	15	7	6
	7	67	10	49	7	6
Cobre	31	13⅜	6	10	12	0
	93	13½	6	10	9	0
	92	12⅜	6	10	12	0
	14	61½	6	45	0	0
	12	14	7	11	0	0
Laxey	80	6⅜	1, 3	4	18	6
Laxey	67	6½	3	£4	15	6
Berehaven	124	11⅛	2, 6	9	4	0
Connorree	69	4⅜	6, 15	3	2	0
	20	6⅛	6	4	12	0
	4	59	5	46	7	6
	4	36	10	28	1	6
Ballycummisk	14	20½	2	16	17	6
	39	10⅛	2	8	2	6
	31	5½	3	4	7	0
Cronebane	3	18½	5	14	0	0
	2	29	5	22	2	0
Tigrony	3	18½	5	14	0	0
	2	29	5	22	0	0
Holyford	4	9½	2	6	17	6
Wallaroo	2	19½	5	15	10	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Cuba	630	£6,264	4	0
Cobre	252	3,037	13	0
Laxey	147	713	18	6
Berehaven	124	1,140	16	0
Connorree	97	603	14	0
Ballycummisk	84	£687	19	6
Cronebane	5	87	4	0
Tigrony	5	86	0	0
Holyford	4	27	10	0
Wallaroo	2	31	0	0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.		
1	Copper Miners' Co.	130	£919	5	0
2	Freeman and Co.	119	1,151	0	6
3	Grenfell and Sons	265	1,665	16	6
4	Crown Copper Co.	—	—		
5	Sims, Willyams & Co.	93	1,573	11	6
6	Vivian and Sons	431½	4,372	0	0
7	Williams, Foster & Co.	248	2,030	8	0
8	British and For. Copper Co.	—	—		
9	Mason and Elkington	—	—		
10	Bankart and Sons	19	£860	18	6
11	Charles Lambert	—	—		
12	Ravenhead Copper Co.	—	—		
13	Sweetland, Tuttle & Co.	—	—		
14	Jennings & Co.	—	—		
15	Neath Copper Co.	34½	106	19	0
	Total	1,340	£12,679	19	0

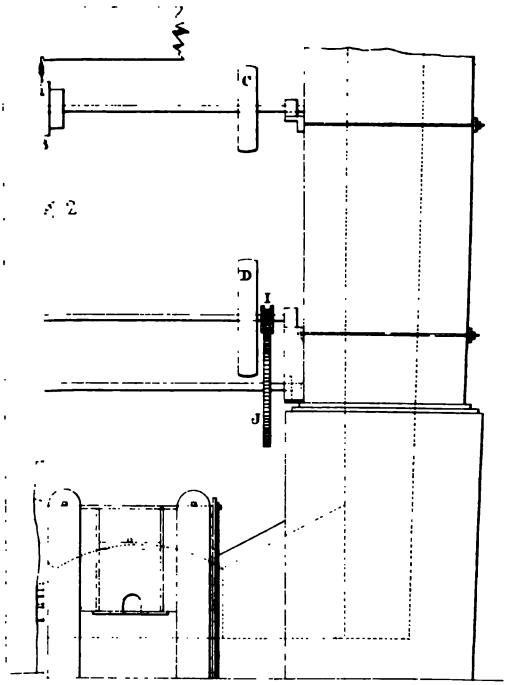
Black Tin Sales.

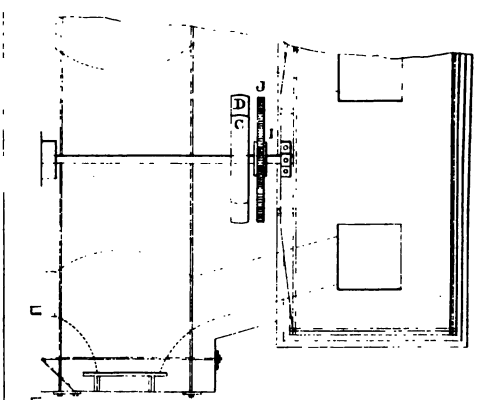
Date.	Mines.	Tons.	c.	q.	lbs.	Price per ton £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Feb. 6.	Cornubia	2	16	3	17	67	10	0	New Blowing Co.	365	9	3
	,,	2	11	1	15	67	10	0	Daubuz and Co.			
,, 18.	Penhalls	5	9	1	5	—			—	364	1	9
,, 19.	West Beam	4	15	3	7	66	7	0	Bolitho	689	18	0
	,,	0	11	0	17	65	12	0	ditto			
	,,	5	1	0	2	66	6	6	W. G. & F. M. Williams			
	Par Consols	52	7	1	21	64	10	0	—	3377	19	8
,, 20.	Trevenen	10	4	2	25	71	5	0	Enthoven and Sons	780	4	4
	,,	1	3	0	15	44	0	0	ditto			
	Wheal Vyvyan	2	2	2	19	64	0	0	ditto	152	17	10
	,,	0	7	1	2	45	0	0	ditto			
,, 25.	Leeds and St. Aubyn	1	8	0	23	67	10	0	Chyandour Co.	123	15	0
	,,	0	9	1	26	60	5	0	ditto			
,, 21.	St. Day United	18	0	1	17	52	0	0	—	937	0	0
	Pedn-an-drea	8	14	3	6	—			Bissoe Co.	608	19	2
Mar 2.	Wheal Grylls	21	13	0	0	69	10	0	Daubuz and Co.	1504	13	6
,, 3.	Great Wheal Busy	24	5	3	19	—			—	1457	15	4
	Great Wheal Fortune	36	10	0	25	—			Mellenear Co.	2641	2	2
,, 6.	Cornubia	2	18	2	11	69	10	0	New Blowing	397	15	10
	,,	2	15	3	14	69	10	0	Daubuz and Co.			
,, 14.	Gurllyn	4	6	3	20	64	5	0	Chyandour Co.	279	5	0
	Kitty (St. Agnes)	15	14	1	23	—			—	1031	18	7
,, 17.	Great Wh. Vor United	28	13	0	12	—			—	2052	1	7
,, 18.	Penhalls	5	4	3	4	—			—	356	18	6
	Pedn-an-drea United	10	1	1	27	—			Carvedras	658	4	0
,, 20.	Wheal Vyvyan	2	8	3	24	66	0	0	Bissoe Co.	182	4	9
	,,	0	8	3	26	46	0	0	ditto			
	Trevenen	9	3	2	23	73	10	0	ditto	727	12	1
	,,	1	2	3	8	46	0	0	ditto			

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £ s. d.	Purchasers.
Feb. 20.	Dyliffe	115	13 15 6	Newton, Keates & Co.
	Newtownards	75	13 5 6	ditto
,, 23.	South Exmouth	80	12 1 6	Treffry's Trustees
,, 24.	Laxey	100	17 0 0	Stock & Co.
,, 26.	Mount Pleasant	4	12 13 6	Adam Eyton
	Hendre Ucha	20	13 16 0	Walker, Parker & Co.
	Bryngwyn	8	14 1 0	ditto
	,,	8	15 0 0	Adam Eyton
	Pwll Bramwell	3	12 17 6	Newton, Keates & Co.
	Dyliffe	85	13 17 6	Adam Eyton
	Roman Gravels	25	13 15 6	Walker, Parker & Co.
	Llanerchyraur	26	14 5 6	ditto
	Harwoood	12	12 12 6	Locke, Blackett, & Co.
,, 28.	Trelawny	61	27 9 0	Sims, Willyams & Co.
	Cwmbrane	10½	13 2 0	ditto
Mar. 2.	East Logylas	45	13 4 6	Walker, Parker & Co.
	Glogfach	60	15 18 6	ditto
	Cwmystwith	100	13 7 6	Adam Eyton
,, 3.	Dyliffe	40	13 14 6	ditto
	Dyfngwm	30	13 14 0	Newton, Keates & Co.
	Aberdovey	13	13 2 6	ditto
,, 4.	Isle of Man Mining Co.	100	21 10 6	Treffry's Trustees
	Chiverton	65	19 10 6	Newton, Keates & Co.
,, 5.	Foxdale	100	14 15 6	Walker, Parker & Co.
,, 6.	Minera	100	13 14 6	Adam Eyton
	,,	100	13 13 0	Walker, Parker & Co.
	,,	100	13 13 0	ditto
	,,	35	13 13 0	ditto
	,,	105	13 13 0	ditto
	,,	100	13 13 0	ditto
,, 11.	Wheal Mary Ann	50	27 7 6	Treffry's Trustees
,, 12.	Talargoch (Maesyrerwddu)	55½	14 17 6	Newton, Keates & Co.
	,, (Coetia Llys)	60	15 3 6	Walker, Parker & Co.
	Deep Level	10	13 7 0	Newton, Keates & Co.
	Brynford Hall	8	12 17 6	ditto
	Rhosesmor	25	8 1 0	ditto
	,,	7	13 5 6	Walker, Parker & Co.
	Parry's	30	13 18 6	ditto
	Bryn Gwiog	35	14 8 6	ditto
	Long Rake	17	14 0 6	ditto
	Merllyn	5	12 11 0	Adam Eyton
	East Merllyn	2½	14 0 6	ditto
	,,	2½	14 0 6	Newton, Keates & Co.
	Grestan	3½	13 7 6	Walker, Parker & Co.
	Holywell Level	10	14 12 6	Newton, Keates & Co.
	Pantymwyn	25	12 8 6	Walker, Parker & Co.
	Llangynog United	22	13 7 0	Newton, Keates & Co.
	Minera Union	10	13 5 6	ditto
	Roman Gravels,	20	13 13 6	Walker, Parker & Co.
,, 13.	Wheal Frank Mills	72	14 3 6	Stock & Co.
,, 16.	East Logylas	120	12 19 0	Sims, Willyams & Co.
	Cefn Brwyno	42	13 6 0	ditto
	East Darren	75	16 1 6	Mining Co. of Ireland
	Cwm Erfin	12½	16 2 6	Panther Co.
	,,	12½	16 2 6	R. Michell & Son
	,,	30	16 8 0	ditto
,, 19.	Dyliffe	32	13 8 6	Adam Eyton
	,,	32	13 8 6	Newton, Keates and Co.
	Dyfngwm	18	13 3 0	ditto
	Cwmbyr	21	11 5 8	ditto

Purchasers.		
Newton, Keates & Co.		
ditto		
Treffry's Trustees		
Stock & Co.		
Adam Eyton		
Walker, Parker & Co.		
ditto		
Adam Eyton		
Newton, Keates & Co.		
Adam Eyton	1179	
Walker, Parker & Co.	346	
ditto	371	
Locke, Blackett, & Co.	151	
Sims, Willyams & Co.	1724	
ditto	140	1
Walker, Parker & Co.	595	2
ditto	955	10
Adam Eyton	1337	10
ditto	549	0
Newton, Keates & Co.	411	0
ditto	170	12
Treffry's Trustees	2152	10
Newton, Keates & Co.	1269	2
Walker, Parker & Co.	1477	10
Adam Eyton		
Walker, Parker & Co.		
ditto		
ditto	7378	10
ditto		
ditto		
Treffry's Trustees	1368	15
Newton, Keates & Co.	825	11
Walker, Parker & Co.	910	10
Newton, Keates & Co.	133	10
ditto	103	0
ditto	293	13 6
Walker, Parker & Co.		
ditto	414	15
ditto	504	17
ditto	238	8
Adam Eyton	62	15
ditto	70	2
Newton, Keates & Co.		
Walker, Parker & Co.	46	11
Newton, Keates & Co.	146	5
Walker, Parker & Co.	305	12
Newton, Keates & Co.	293	14
ditto	132	15
Walker, Parker & Co.	273	10
Stock & Co.	1020	12
Sims, Willyams & Co.	1544	0
ditto	558	12
Mining Co. of Ireland	1205	12
Panther Co.		
R. Michell & Son	895	2
ditto		
Adam Eyton		
Newton, Keates and Co.	859	4
ditto	236	14
ditto	236	19





Scale of Figs 1. 2. & 3 1/60th

Scale of Figs 4. to 11 1/20th

THE

MINING AND SMELTING MAGAZINE.

MAY, 1863.

The Iron Manufacture of the Centre of England.

(For Merchant Bars and Plates.)

By MM. Gruner and Lan.

(Abstracted from the *Annales des Mines*, 5th series, vol. xx, p. 583.)

(*Continued from page* 203.)

The Making of the Pig-Iron.

1. *Forms, Arrangement, and Working of the Blast-Furnaces of South Staffordshire.*—The normal product of the South Staffordshire blast-furnaces is bright grey forge-pig, like Nos. 3 and 4 of Blaenavon and Yniscedwin in Wales. But, besides this normal product, certain iron-masters also apply themselves to produce, either pig-iron of a darker grey (Nos. 1 and 2) for foundry purposes, or mottled or white pig (Nos. 5 and 6) for soft irons of inferior quality. But they never go so far as the black pig of Scotland, or as the granular white pig of Wales.

Of course, it is to be supposed that the iron-masters of South Staffordshire, in order to produce either superior grey pig, or inferior mottled pig, have recourse to the same means as the Welsh iron-masters, namely:—

For superior pig-iron, a hot working, coke, sometimes cold air, and generally Coal-measure ores exclusively. For inferior pig-iron, a half cold working, raw coal, hot air, and ordinary ores, either of the Coal-measures or imported. In the latter case also, forge cinders are added, but generally at most 10 per cent. As to the *normal* pig-iron of Staffordshire it is generally obtained with hot air, with a mixture of raw coal and coke, and by charging two-thirds of the ores of the district with one-third of imported ores. At most 5 per

cent. of forge cinders are added, and then only the cinders coming from the heating furnaces.

We shall not enter here into all the details of the relative forms of the Staffordshire furnaces compared with those of other districts.* The modern blast-furnaces (See *Mining and Smelting Magazine*, vol. i, Plate III, Fig. 4) have almost all, like the old ones, very flat boshes; still, in some works, enlarged hearths and high and steep boshes have also been adopted, of which furnace No. 3 of the Bilston Works is an example (See *Mining and Smelting Magazine*, vol. i, Plate III, Fig. 3). But this innovation does not seem to us to be advantageous to the production of grey pig. However desirable may be the enlargement of the upper portions in order to make a large production possible, the exaggerated enlargement of the hearth is, on the other hand, just as hurtful as regards the consumption of fuel; and this can only be partially remedied by the multiplication of the number of twyers.

The capacity of the body, without being as colossal as that of the larger Welsh furnaces, is, however, at present from 155 to 170 cubic yards, instead of from 90 to 97 cubic yards the ordinary capacity about the year 1830. In some exceptional blast-furnaces, like No. 3 of Bilston, it reaches as high as 228 cubic yards. But, the capacity being equal, the Staffordshire furnaces, from the warmer nature of the pig-iron, have not nearly so large a production as those of Wales. The descent of the charges is slower; and, per ton of pig produced in the twenty-four hours, the interior capacity reaches from 9 to 10 cubic yards, instead of from 6½ to 8 cubic yards, as in Wales. As regards the other dimensions, if, during thirty years, the capacity of the furnaces has nearly doubled, it is almost entirely due to the enlargement of the body and of the throat. The height has varied little, and it might be difficult to increase it on account of the friability of the fuel. It is now from 40 to 43 feet, 47 feet is a maximum rarely attained. The bodies are at present from 13 to 15 feet; the throats from 8 to 10 feet.

The large blast-furnaces of Staffordshire have generally two parallel twyers in each of the three embrasures: we have nowhere seen any in front. Most of the furnaces have exteriorly, as far as the body, the ordinary pyramidal form, while the upper portion is conical, bound with iron hoops. At the Russell Works, near Dudley, the exterior of the body of two new furnaces, which are covered with wrought-iron plates, is supported by columns, which admit of the use of five convergent twyers, symmetrically arranged round the centre. Such a blast-furnace costs at present in Staffordshire, without the blast-engine, hot air, and other accessory apparatus, from 1,200*l.* to 1,300*l.*; and each hot air apparatus, 375*l.*

In Staffordshire the utilisation of the gases is quite exceptional; indeed, we have nowhere observed it. In general the iron makers of this district dread innovations, and, even more than elsewhere, have an objection to men of theoretical knowledge: beyond the

* This question is fully discussed in the general portion of Messrs. Gruner and Lan's memoir. In the original this precedes the description of the separate districts, but we have considered it more convenient to take the separate districts *first, and to* conclude with the general comparisons.—Ed. M. & S. M.

"practical man" there is no hope.* However, in Staffordshire as in Wales, hot air and raw coal have long been in general use. But in this district also there has been a recognised deterioration in the pig-iron. The iron-masters who think more of quality than cheapness have returned to cold air and carbonised (desulphurised) coal. Besides, in England, the low price of fuel renders the advantages of hot air less considerable than on the Continent.

The accessory arrangments of the Staffordshire blast-furnaces, such as the lifting apparatus, blowing machines, casting-houses, hot air apparatus, &c., have nothing special about them. The old forms, elsewhere abandoned, are here still frequently used.

The composition of the charges and the working of the furnaces do not differ from those of other districts, already described. We shall only mention that the working is moderately hot, and that, owing to the extreme fusibility and reductibility of the Coal-measure ores, there is never any difficulty in managing the furnaces. It is so easy, in fact, that in most works the furnaces are allowed to stop from Saturday to Monday. It is sufficient on Saturday evening to make a few light charges, and then to close the twyers and the throat. On Monday morning on the blast being re-admitted, the furnace immediately resumes its ordinary working without the least disarrangement.

Owing to the predominance of the Coal-measure ores and the relative scarcity of forge-cinders the slags contain little iron, and always affect, after cooling, the clear olive tint, with an enamelled appearance, of the earthy proto-silicates, impregnated with sulphur and manganese.

The flame from the throats is always white and bright, when working with raw coal, and all the more voluminous in Staffordshire as all the coals of the district are rich in volatile matters. Still these coals have not the fault of the anthracites—and of the coals of the Scotch district—they do not choke up the hearth with unconsumed small.

Each blast-furnace requires per twelve hours a foreman-caster and a charging-foreman, with a certain number of assistants. Almost all, even the men employed in coking, are paid at so much per ton of pig. It is calculated that the prices paid yield on an average the following rates of wages:—

	s. *d.*		*s.* *d.*
Foreman-caster, per day, from	5 0	to	5 3
Charging-foreman	3 6	„	3 9
Fillers, heaters, tool-makers, &c.	2 10	„	3 6

While each ordinary labourer earns from 2*s.* to 2*s.* 4*d.* per day, and mechanics 26*s.* per week.

The Staffordshire pig-metal is much superior to that of Scotland or Wales. It is more tenacious than the former, and yields better iron than the latter; but we cannot sufficiently repeat that this superiority is due less to the ores than to the processes of smelting. If in Scotland the coal were everywhere carbonised and the working less hot, and if in Wales the cinders were suppressed, the pig-iron

* We are far from desiring to say anything against practice, but we think a little theory in addition would do no harm.

in these two districts would differ little from that of Staffordshire. Still the special nature of the Scotch ores increases the difficulty of producing such pure and tenacious pig-iron, as that which can be obtained in certain works of the centre and south-west of England. Besides, it must be remembered that the best Staffordshire metal is all more or less phosphoretted, and cannot in any way be compared with the metal, smelted with wood, of Comté, of Berry, and of Périgord.

If we go through the numerous Staffordshire works, we see at a glance that, in respect of uniformity of products, this district much more resembles Scotland than Wales. With very few exceptions the object is everywhere to produce the same grey forge-pig; and if it is not always equally pure, owing to the more or less exclusive use of raw coal or of coke, of hot air or of cold, the differences are yet less considerable than in Wales.

2. *General Results.*—According to Mr. Hunt, South Staffordshire included—

	Tons.
In 1857, 180 blast-furnaces, 158 in blast, producing ..	657,295
In 1858, 186 „ 147 „ „ ..	597,809

That is 4,000 tons per blast-furnace, or from 12 to 13 tons per twenty-four hours.

This average is small, either on account of the interruption of Sunday, or because most of the blast-furnaces retain still the old capacity of from 90 to 97 cubic yards, and consequently do not yield more than 10 tons per twenty-four hours. Among the most modern ones even, there are few which reach 20 tons. Only the largest, like No. 3 of the Bilston works, reach as far as 24 tons.

In the South Staffordshire blast-furnaces the capacity of the body, with regard to its production, occupies, as might be expected from the nature of the metal, an intermediate position between those of the Scotch and those of the Welsh furnaces: that is, on an average 9 cubic yards per ton of pig.

The pressure of the blast varies, as in Wales, between five and six inches; its temperature between 300° C (572° Fahr.) and 330° C. (626° Fahr.) The volume of blast per ton of pig is 8,500 cubic yards for grey forge-pig with hot air, and from 9,700 to 10,000 cubic yards for foundry-pig with cold air. It is more than in Scotland on account of the lower produce of the ores. The consumption per ton of grey forge-pig, for the simple smelting, working with hot air and principally raw coal, is from 2 tons 15 cwt. to 3 tons of raw fuel, or from 1 ton 8 cwts. to 1 ton 10 cwts. of fixed carbon; and when working with cold air and coke from 3 tons to 3 tons 10 cwts. of raw fuel, or from 1 ton 10 cwts. to 1 ton 16 cwts. of fixed carbon. There is consumed besides, more or less small coal; for calcining 2 cwts., and for heating the boilers and blast from 15 cwts. to 1 ton 2 cwts. This is a greater consumption than in Scotland and Wales, because the pig-metal is less hot and the coal more carburetted in the latter; while the ore is richer and the blast hotter in the former. For these reasons a ton of coal in Staffordshire smelts a less weight of ore and limestone. Consequently the cost-price is higher, as will be seen by the following details.

The normal forge-pig-metal obtained with hot air and without forge cinders, cost, on an average, during the eighteen months ended 31st May, 1860, in one of the principal works of Staffordshire, 3*l.* 15*s.* 3*d.* per ton (20 cwts. longweight). The working was half with coal and half with coke, and almost exclusively with Coal-measure ores. The following are the details:—

	Tons.	Cwts.		*s.*	*d.*		£	*s.*	*d.*
Coal-measure ore (weighed raw)	2	8	at	13	9	=	1	13	0
Red hematite	0	7	„	20	0	=	0	7	0
Total of ore	2	15					2	0	0
Coal for smelting	2	16	„	7	0	=	0	19	7
Small for calcining, hot air, and boilers ..	1	4	„	3	0	=	0	3	7
Limestone	0	9	„	2	0	=	0	0	11
Labour							0	7	0
General Charges, not including interest..							0	4	2
Cost-price of forge-pig-metal per ton (20 cwts. longweight)							3	15	3*

In other years we have found it to be, for the same period, 3*l.* 10*s.* and 3*l.* 7*s.* To arrive at these prices it is sufficient to increase the proportion of raw coal, to charge from 5 to 10 per cent. of forge cinders, or to replace a part of the Coal-measure carbonates by the hydrated and oolitic ores of the secondary formations. In that case the cost of the ores is reduced to 35*s.* or 36*s.*, and the quantity of coal consumed to 2 tons 10 cwts., costing 17*s.* 6*d.* Besides, with a larger production the labour and general expenses may be slightly reduced. On the other hand when the working is exclusively with coke, 3 tons of coal are consumed, and the labour is to some extent increased on account of its total carbonisation; in which case the cost-price advances to 3*l.* 18*s.*

Thus, in most works, the cost-price of the Staffordshire grey forge-pig varies at present between 3*l.* 7*s.* and 3*l.* 18*s.* Now this latter price scarcely differs from that of 1830, a period when coke alone was consumed; for it is about that given by the authors of the *Voyages Métallurgiques*. Thus the cost-price of identical qualities has remained stationary during thirty years. If the total consumption of coal (for smelting, boilers, calcining, and blast) has been reduced during this period—from 6 or 6½ tons to 4 tons, the price of the raw materials has, on the contrary, increased so much as to balance this saving in fuel; if, in a certain number of works, the cost of the pig-iron has been reduced to 3*l.* 7*s.*, this is due to the more general use of raw coal, and the addition of forge-cinders or inferior ores, which considerably deteriorate the quality of the metal.

We repeat that for products of equal quality, the pig-iron is as dear as in 1830. The complete utilisation of the gases for heating the blast and the boilers, does not, considering the low price of small coal, lead to an economy of more than 2*s.* or 3*s.*; thus, taking into account the continual augmentation of cost in the labour and in the

* In comparing these prices with those of Wales, it must not be forgotten that part of the difference is due to the profit tacitly included in this district in the *prices charged for the coal* and ore.

ores, we may conclude that, as in Wales, the Staffordshire iron-masters have reached the lowest limit of cost in respect of the making of pig-iron, and that for the future the cost may be expected to increase rather than diminish.

But besides the grey pig-metal of which we have just spoken—the normal product of the district—Staffordshire also produces other qualities of pig-iron, differing from this in two opposite directions. Some works, yielding to the temptation of manufacturing cheaply, have gradually increased the quantity of cinders, and have finally arrived at the production of white pig, resembling in every respect that of Wales. In this case the cost-price may be reduced as low as 2*l.* 15*s.* On the other hand, if the production of superior cold air pig-iron is desired, the cost-price exceeds the average of the normal products of the district by from 10*s.* to 15*s.*, and then reaches from 4*l.* 5*s.* to 4*l.* 10*s.* per ton, which is that of metal of a similar quality at Pontypool. We may add that this cold air pig-iron scarcely amounts to 10 or 12 per cent. of the total production.

Lastly, if instead of the hot air grey forge-pig, it is specially desired to produce the superior numbers for foundry use, the consumption is increased by half a ton, and the production is less. The cost-price is then from 4*l.* to 4*l.* 5*s.*, instead of from 3*l.* 15*s.* to 3*l.* 18*s.*

3. *Markets and Conditions of Sale.*—The Staffordshire pig-iron, like that of Wales, is specially intended for forge use; at most from 15 to 20 per cent. being sold as foundry-pig. The latter is mostly cast in the district itself, at Birmingham or in the neighbourhood; but a very small portion is sent any distance under the form of raw-pig. The forge-pig is also almost entirely refined in the district; and in addition some of the Staffordshire forges purchase a certain class of pig-iron from the neighbouring districts of Shropshire and Derbyshire, or that obtained from the red ores of Cumberland and Durham. In every case the Staffordshire pig-iron is much more a market product than that of Wales. For if some large works include both blast-furnaces and forges, there are others which contain only furnaces and produce crude-iron, and others again which contain only forges and refine the iron.

In order to facilitate the sale of pig-iron, it is always classed into six numbers:—

Nos. 1 and 2 as foundry-pig.
„ 3 „ 4 (normal product) as grey forge-pig.
„ 5 „ 6 (accidental product, mottled or white) as inferior forge-pig.

The pig-iron is sold delivered at the works, or loaded in boats or trucks on the canals or railways which traverse them.

We might give for the recent years the quarterly price current, like that given for the Welsh district (See *Mining and Smelting Magazine*, vol. iii, No. 14, p. 81); but it would be almost a repetition, for in both districts, the quotations vary simultaneously. We may refer particularly to the commercial crisis of 1857, which from September to December caused, as in Wales, a sudden fall of 10*s.* on pig-iron, and of 1*l.* on bar-iron. Mr. Hunt's statistics for 1857, show the effect of this fall on the industrial activity of Staffordshire. In the month of September, out of one hundred and eighty blast-furnaces twenty-four only were idle, while in December there were

already sixty-nine out of blast. The labour was at the same time reduced by 12½ per cent. on the total of the works and mines; the puddlers particularly had to submit to a reduction of 1*s.* per ton on the raw pig.

Since the end of 1857, the prices have remained almost stationary, except a fresh fall of 10*s.* about the middle of 1860. At the end of 1859, the selling prices were as follows:—

Nature of the Products:—

	Price per Ton.	
	Hot Air.	Cold Air.
Inferior white forge-pig, with a large quantity of cinders	£ *s.* £ *s.* 2 16 to 3 0	£ *s.* £ *s.* (*a*)
Normal forge-pig, Nos. 3, 4, and 5	3 8 „ 4 0	4 5 to 4 10
Foundry-pig, Nos. 1 and 2	4 0 „ 4 10	4 10 „ 5 0

(*a*) Not made with cold air.

In comparing these selling prices with the cost-prices we see that the profit is almost nil. Thus, in taking the normal forge-pig, the cost-price of which varies between 3*l.* 7*s.* and 3*l.* 18*s.*, and the selling price between 3*l.* 8*s.* and 4*l.*, we see that the average profit, including the interest of capital, would not be more than from 1*s.* to 2*s.* per ton. It must be remembered, however, that the principal iron-masters are also proprietors or lessees of mines, and thus make a profit of from 1*s.* to 2*s.* per ton on the coal and ore consumed. Their position is not therefore so deplorable as would appear from a comparison of the preceding figures. But those who have not these resources have really, for some years, been in a very critical position; and, in fact, in consequence of the fresh fall in 1860, many works have been forced to suspend, and some others have failed.

The general condition of the iron industry of Staffordshire has not consequently, for the last four years, been in a better position than that of Wales. We may mention, in conclusion, that the Staffordshire iron-masters have not like the Scotch, a general depôt, where they can deposit their stock of pig-iron in exchange for warrants. Their object rather is to create stocks of bar-iron; but these latter are generally in the hands of London and Liverpool merchants, and are not much profit to the iron-masters of the district.

The Lowmoor and Bowling District, in the West Riding of Yorkshire.—The most esteemed iron of the United Kingdom (both for casting and for wrought-iron), is furnished by a certain number of works grouped round the town of Bradford, towards the northern extremity of the central coal-basin. This district includes thirteen works, with thirty-three blast-furnaces, of which twenty-four produced in 1858, 85,936 tons of pig-iron. The most celebrated works of the district, for the quality of its products, is Lowmoor; Bowling and Bierley come next, and then Farnley. These four works are also the most considerable, for Lowmoor includes six blast-furnaces; *Bowling* five; Bierley four; and Farnley four. Each of

these also comprises a foundry and a forge, for the sale of the raw pig is entirely exceptional.

We have only visited Lowmoor, and consequently shall only speak of that establishment; but the conditions and modes of manufacture at Bowling and Bierley are almost identical. Bowling particularly is similarly placed to Lowmoor, for the two works are little more than a mile apart. They are both on the northern border of the central basin, not far from the Millstone Grit, and in the centre of the waste table-land which overlooks Bradford. In this respect, as well as regards the supply of coal and ore, their position much resembles that of the large Welsh works; the fuel and the ore are raised on the spot by the proprietors of the works, who together possess many square miles of ground. The coal costs 5*s.* or 6*s.*, and the ore 10*s.* or 12*s.* per ton. The coal is hard, with a long flame like that of Staffordshire; but seems, however, more caking, for the small can, at least partly, be coked in kilns. The coal of this district contains, besides, very little pyrites, especially that which comes from the *Better Bed* of Lowmoor. It is to the perfect purity of this fuel, and to the particular care taken in the make, rather than to anything special in the ores, that the excellence of the Lowmoor products is to be attributed.

The ores treated in the works of this district differ, in fact, in no way from the ordinary Coal-measure ores; this Dr. Percy positively declares.* Two bands are principally worked, the *White Bed mine* and the *Black Bed mine.* The following is their composition according to Dr. Percy:—

	Ore of the White Bed.	Ore of the Black Bed.
Oxide of Iron	36·58	36·75
Oxide of Manganese	·94	1·38
Lime	2·78	2·70
Magnesia	2·22	2·05
Alumina	0·80	0·52
Carbonic Acid	25·41	26·57
Phosphoric Acid	0·48	0·34
Iron Pyrites	0·18	tr.
Water	1·85	1·77
Bituminous Matter..	0·23	2·40
Insoluble Residue	28·00	25·27
	99·47	99·85
The insoluble residue is composed of:—		
Silica	19·13	17·37
Alumina	6·83	6·22
Oxide of Iron	0·57	0·84
Lime	0·11	tr.
Magnesia	0·07	0·12
Potash	0·78	0·65
	27·49	25·20

Both ores contain 29 per cent. of metallic iron..

* Memoirs of the Geological Survey: the Iron Ores of Great Britain, Part I, p. 31.

Like all the Coal-measure carbonates of the United Kingdom, those of Lowmoor are very fusible and very reductible; but phosphoric acid is as abundant in them as in those of Staffordshire. Neither is there a greater proportion of manganese, pyrites alone being perhaps a little less frequent. For some years a small quantity of the pure pulverulent red ore of Cumberland has been added to the Coal-measure ore.

In order to obtain from these ores pig-iron of a superior quality, the methods adopted are the same as those of Pontypool and of the Staffordshire works, which produce pig-metal of high tenacity and purity.

The coal is completely carbonised—the small in kilns, the large in heaps.

The ore is exposed a long time to the air, then carefully picked and calcined in kilns.

The blast-furnaces are worked with cold air, fed exclusively with coke, and without cinders. They work hot; but, in order to avoid the reduction of extraneous matters, one ton of limestone is charged per ton of pig-iron, as at Pontypool.

The reduction of the silica and of the earthy metals is also sought to be prevented by the relatively large dimensions of the region of fusion, or rather by the absence of boshes properly so called (See *Mining and Smelting Magazine*, vol. i, Plate III, Fig. 15). For fear of injuring the products, the greatest care has been taken for a very long time to avoid any modifications in the works. The blast-furnaces are still the same as they were thirty or forty years ago. Not only has no trial ever been made of hot air, of raw-coal, or of utilising the gases, but even the old open twyers are still retained —three in number as formerly. The only modification which has been suffered for the last thirty years is the addition to the charge of a very small quantity of the pulverulent red hematite of Cumberland.

The slags, like those of Pontypool, are basic and stony (*short*), and are specially characterised by the olive tint of the sulphide of manganese.

The production of the blast-furnaces does not exceed 10 tons per twenty-four hours, or from 3,000 to 3,500 tons per year. The principal object is to obtain Nos. 2 and 3—bright and medium grained, but of rather dark colour. The consumption of coal as at Pontypool, is, at least, 4 tons for the smelting proper, and about 5 tons, including the coal for calcining and for the boilers.

We have not the necessary data for estimating exactly the cost-price of the pig-iron, but, as the ore and the coal are about as dear as in Wales, it cannot be far from 4*l.* 5*s.*

Nos. 1 and 2 are remelted for marine artillery, which is turned out completely finished from the works. No. 3 is used for the making of bar-iron, or rather is made almost exclusively into superior sheets, and tires for locomotives. As we shall show further on, although this iron is relatively pure, it still requires to be submitted to a special and very complicated method of refining, in order to obtain superior iron, capable of rivaling the good French iron made with wood.

Out of the six furnaces, five are generally in blast. Their annual production is about 17 or 18,000 tons. A part of this, as we have seen, is cast into artillery, but the mass is refined, and annually furnishes about 10,000 tons of malleable iron. The production of Bowling is about the same; and that of Bierley and Farnley a little less.

Neither Lowmoor nor Bowling ever sell iron in pig. Both establishments have for a long time been in a prosperous condition. We may add, in conclusion, that the cost of the carriage of the iron by railway to Liverpool is 14*s*. per ton.

On Mechanical Puddling.

As Adopted at the Clos-Mortier Forges, Haute Marne.

Note by MM. Dumeny and Lemut.*

The importance of applying some mechanical means to aid the laborious operations of puddling, is too obvious to require dwelling on, in the face of the great and growing importance of the iron manufactures in every part of the world. By the adoption of the arrangements hereafter described we believe we have succeeded in securing the following advantages:—

1. An economy in the consumption of materials, and an improvement in the quality of the products, by a more rapid and complete working; and,

2. A diminution in the labour of the working puddler, by which the occupation may be thrown open to a greater number, and the period of life to which they can follow it extended. At present only men of strong constitution are able to adopt it, and among these only the strongest are able to continue it for fifteen years.

The idea of giving the puddler the aid of auxiliary machinery is certainly not new; and when we see in every branch of human industry, so many ingenious apparatus lending the aid of their almost illimitable power to man, leaving him only the controlling intelligence, we are certainly surprised that the aid of steam has not yet been brought to bear upon puddling, one of the operations that requires the greatest and most fatiguing efforts, and which is carried on in places where this motive power could be made available at a trifling cost by the utilisation of the flames of the furnaces themselves.

Still, when we observe the variety of movements which the working puddler executes with his rabble in every portion of the furnace, and the necessity there is for continually renewing this tool, so readily destroyed by the fire and the contact with the fused matters; and then the change of nature which takes place in the crude metal, and the intelligent manipulation which the iron requires

* *Annales des Mines*, 6th Series, Tome II, 4th livraison de 1862.

in its spongy state; we cannot help feeling that machinery which would be applicable to such a complicated working, would itself be too complicated and too costly to be really practical—too troublesome and too minute to be placed near a puddling furnace, and under the control of a working puddler. Fully aware of these difficulties, we have not raised our pretensions so far as to propose carrying out mechanically all the operations of puddling. Our object has only been to effect the raking of the crude metal by our mechanical puddler, which we might also call the helper-puddler, since, like him, it works up the crude iron.

Simple Mechanical Puddler.—The most simple application of the mechanical puddler consists in making it work in an ordinary furnace. The customary tools remain without change, and are introduced, as usual, by the small opening in the door. The apparatus from which they receive their movement is arranged above the furnace, so as not to interfere with its approaches; and by means of a simple arrangement the working puddler controls or stops it at his will. The principle of the apparatus will be readily understood from Plate IV. An iron swing-beam H H is suspended from a wooden beam so as to hang in front of the furnace door, and to the lower part of this the rabble, or other tools, are attached in a few seconds. This beam—which receives by means of a connecting-rod and a guiding groove, in the manner pointed out further on, a complex oscillating movement in a plane which itself oscillates to the right and the left of the axis of the door—directs and works the tool into every portion of the furnace, exactly the same as the hands of the workman, but with a much greater and unceasing energy. When the raking is finished, and the heat has come to nature, the working-puddler stops the apparatus, puts aside the beam H H, and commences, in his turn, to work the iron in the usual manner.

The details of the apparatus are shown in Figs 1 to 11 of the plate.

The movement which the apparatus receives from the drum B is transmitted by a driving band from C to D, and from D by the shaft to the disc-crank F—which, by means of the connecting-rod G (ending in two universal joints shown in Figs 9, 10, and 11), controls the movements of the swing-beam H H, to which are attached the tools working in the furnace. The bearer which carries the axle of the disc-crank F is fixed at the upper end of the oscillating pedestal M N O, which has a slow oscillating movement on the horizontal axis O—a movement given to it by means of the excentric Q, which receives its movement from the shaft connected with a large tooth-wheel J, moved by the pinion I. The swing-beam H H, and consequently the rabble, has thus a movement which results from the rotation of a crank about an axis which is slowly displaced.

In addition to this, the rod H H is confined between the two bars R R, forming a groove which guides the plane of its oscillation, and which, moving on the vertical axis S, varies this plane, and with it the direction the rabble takes in the furnace. This guiding groove R R receives its movement round the axis S by means of the rod T connected with the arm U, which is put in motion by the disc-crank L, fixed on the same shaft as the excentric Q.

By this apparatus every movement of the tool can be regulated in a few moments:—

1st. The portion of the drum B which gives the most suitable motion can be selected.

2nd. The apparatus can be instantaneously stopped, or put in motion, by the tightening pully E which the workman controls at pleasure by means of the lines *f f*.

3rd. In order to vary at will the extent of the movements of the swing rod H H, the disc-crank F is provided with a number of holes, into either of which the crank-pin μ can be fixed. The same result is to a certain extent attained in fixing, by means of tightening screws, the end of the connecting-rod G at a greater or less height on the swing beam H H.

4th. The two extreme positions which can be given to the rabble in the furnace are regulated: (*a*) by the radius given to the crank formed (like that described in the case of the disc-crank F) on the disc L provided with holes to alter the crank-pin μ; (*b*) by the length of the connecting-rod T which works the bent lever R U, guiding the direction of the tool; and (*c*) by the radius given to the working of this lever. The workman, in a few seconds, can modify at will these lengths by changing the hole of the pin which unites the connecting-rod to the lever.

5th. The displacement of the axis of the disc-lever L can also be varied according to the requirements of the work. For this purpose, the excentric which produces this displacement instead of being fixed directly on the shaft from which it receives its movement, is attached by bolts to the disc-crank fixed on the same shaft. The oblong slot with which the disc of the excentric is pierced allows of its being brought more or less near the centre of the axis of rotation, by altering the bolts.

6th. The general arrangement shown in Figs. 7 or 8 also affords the means of establishing, between the radius of the excentric Q and that of the crank which controls the guiding grooves R U, the angular distance which corresponds to the most suitable proportion between the direction of the rabble and the extent to which it is pushed into the furnace.

7th. According to the length of the tools used in the furnace, the swing rod H H is brought nearer to, or put farther off from, the door of the furnace by lengthening or shortening the connecting rod G, by the means shown in Fig 11.

Lastly, according to the height of the sole and the form of the tool, the inclination of the latter can be altered by the workman connecting (by the tightening screws) the end of the rabble higher up or lower down on the swing rod H H.

(*To be continued.*)

The late John Taylor, F.R.S.

We have to announce the death of Mr. John Taylor, who expired on Easter Sunday last, in his eighty-fourth year, having been born on the 22nd of August, 1779.

Although born in the eastern counties—at Norwich—Mr. Taylor became, very early in life, connected with Cornish and Devon Mining, having taken the management of Wheal Friendship, near Tavistock, in 1798, when only nineteen years of age. The success of this mine, and of others in the neighbourhood, gained for Mr. Taylor an opening, which, coupled with his ability, energy, and above all his high character, immediately secured for him a prominent position among those connected with the metallic mining industry of the kingdom. Indeed, to a certain extent, Mr. Taylor may be said to have opened out a new career; for he was one of the first who was the means of largely introducing into the mining districts the capital of other parts of the kingdom.

Mr. Taylor's greatest step in life, however, was achieved twenty years later. In 1819, he started the Consolidated Mines, in Gwennap, the magnificent success of which is so well known, and which at once placed Mr. Taylor at the head of English metallic mining, and made his name universally known.

But Mr. Taylor's operations were not confined to the western counties. In Derbyshire, in Wales, and in the northern counties, he applied the same enlarged views and improved mechanical appliances to the working of metallic mines; and he also became the mineral agent of the Duke of Devonshire, and of the Commissioners of Greenwich Hospital.

The political sympathy excited in this country by the policy of Mr. Canning in favour of the new-born Spanish-American republics, coupled with the extraordinary sanguine views on the Mexican mines, then just published by the late Baron Von Humboldt, naturally attracted the attention of English enterprise towards those countries. Mr. Taylor especially appears to have been deeply impressed with the marvellous mineral wealth shown by Von Humboldt to exist in Mexico; and he took up the subject with a sober enthusiasm which seems to have been one of the features of his character, as it is of all men who achieve remarkable results. The companies he then founded, supported by some of the most eminent capitalists of the United Kingdom, failed unfortunately to realise the expectations with which they were started; but subsequent results have shown that the failure was due more to faults in administration—perhaps unavoidable—than to any intrinsic demerits in the concerns themselves.

To follow during the last thirty years the mining career of Mr. Taylor, and of the well-known firm of Messrs. John Taylor and Sons,—of which, associated with his sons John and Richard, he was the head—would be almost to give a history of British metallic mining enterprise. In every mining district of the United Kingdom —in France, in Spain, in Germany, in Italy—in America and in the Australias—the name of John Taylor has become a household wherever *English mining* enterprise has penetrated.

Although never strictly a scientific man, Mr. Taylor occupied for many years a prominent position in the scientific world. He contributed many important papers to scientific periodicals on mining and its associated sciences, and was the author of the Report on Mineral Veins, read at the third meeting (at Cambridge, in 1833) of the British Association, of which Association he was one of the original founders and trustees, and also Treasurer from the commencement until last year. He was elected a Fellow of the Geological Society in 1807, and of the Royal Society in 1825. He was also a member of the Council of the London University, being a consistent supporter of the political and religious party by which that institution was founded.

Although in the enjoyment of excellent bodily health, considering his great age, the late Mr. John Taylor had ceased for some years to take any very prominent part in the business of the firm. He had the satisfaction, however, of seeing, that under the management of his sons, it had not merely retained the character and position which he had gained for it, but had extended its influence and its operations into almost every branch of mining and metallurgy, so that the firm of John Taylor and Sons may be said to have become one of our Mining Institutions.

Abstracts and Reviews.

THE BOARD OF TRADE RETURNS.

The "Accounts relating to Trade and Navigation of the United Kingdom, for the month ended 28th February, 1863, and two months ended 28th February, 1863," have been issued by the Statistical Department, Board of Trade.

IMPORTS.—The quantities and relative increase and decrease of the imports of metals, metallic ores, and mineral products, for the month and two months ended 28th February, have been as follows :—

	Month ended 28th February.			Two Months ended 28th February.		
	1862.	1863.	Increase (+) or Decrease (−).	1862.	1863.	Increase (+) or Decrease (−).
Brimstone ... ... cwt.	79,239	100,120	+ 20,881	116,030	117,538	+ 1,508
Copper Ore ... ... tons	6,735	4,558	− 2,177	12,447	8,796	− 3,651
Copper Regulus ... ... „	5,230	2,136	− 3,094	5,763	4,312	− 1,451
Copper, unwrought and part wrought ... } cwt.	26,260	17,300	− 8,960	30,020	20,480	− 9,540
Iron, in Bars, unwrought tons	681	634	− 47	978	1,155	+ 177
Steel, unwrought ... „	93	88	− 5	149	101	− 48
Lead, Pig, and Sheet ... „	1,411	1,993	+ 582	1,891	2,605	+ 714
Spelter or Zinc ... ... „	347	1,165	+ —	684	1,891	+ 207
Tin, in Blocks, Ingots, Bars, or Slabs ... } cwt.	3,916	3,118	− 818	6,232	3,118	− 3,114
Silver Ore... ... value in £	57,278	18,590	− 38,688	89,448	26,640	− 62,808
Petroleum ... ...tuns	678	830	+ 152	686	1,327	+ 641
Quicksilver ... ... lbs.	44,231	166,171	+121,940	44,231	166,171	+ 21,940

EXPORTS.—The quantities, declared value, and relative increase and decrease of the exports of metals, minerals, and metallurgical articles of ...nd Irish produce and manufactures, for the month and two ...d 28th February, have been as follows :—

	QUANTITIES.				DECLARED VALUE.					
	Month ended 28th February.		Two Months ended 28th February.		Month ended 28th February.			Two Months ended 28th February.		
	1862.	1863.	1862.	1863.	1862.	1863.	Increase (+) or Decrease (−)	1862.	1863.	Increase (+) or Decrease (−)
					£	£	£	£	£	£
Alkali: Soda ... ...cwt.	137,722	165,803	253,219	290,506	56,050	69,934	+ 13,884	103,096	121,153	+ 18,057
Coal, Cinders, and Culm ... ...tons	510,552	519,525	1,011,121	974,309	239,080	236,849	− 2,231	473,218	454,312	− 18,906
Iron, Pig and Puddled ... ... „	26,942	26,955	50,490	53,754	71,898	74,360	+ 2,462	136,889	147,661	+ 10,772
Iron, Bar, Angle, Bolt, and Rod... „	18,803	24,083	37,008	45,074	132,082	178,642	+ 46,560	259,002	331,704	+ 72,702
Railroad Iron, of all sorts ... „	23,659	30,484	38,223	53,169	176,042	209,562	+ 33,520	283,712	370,710	+ 86,998
Iron Wire, except Telegraphic (See below) ... ... „	539	1,573	955	3,063	13,178	34,868	+ 21,690	24,529	62,160	+ 37,631
Iron, Cast ... ... „	3,945	6,163	7,747	11,142	36,707	54,197	+ 17,490	78,789	92,500	+ 13,711
Iron Hoops, Sheets, and Boiler Plates ... ... „	4,718	9,559	9,407	16,004	47,307	108,880	+ 61,573	92,264	169,279	+ 77,014
Iron, wrought, of all sorts ... „	4,655	7,450	11,138	13,938	98,125	138,115	+ 39,990	246,539	270,476	+ 23,937
Iron, old, for re-manufacture ... „	899	1,106	942	1,685	3,265	3,640	+ 375	3,380	5,691	+ 2,311
Iron Steel, unwrought ... ... „	1,825	1,974	3,339	3,703	59,423	67,299	+ 7,876	109,747	121,204	+ 11,457
Copper, unwrought, in Ingots, Cakes, or Slabs ... ... cwt.	5,060	9,568	11,490	15,136	25,584	44,520	+ 18,936	59,814	71,505	+ 11,691
Copper, wrought or partly wrought, Bars, Rods, Bottoms, Pans, Plates, Sheets, and Nails; and mixed or Yellow Metal for Sheathing .. „	19,307	34,502	37,605	54,138	98,442	156,961	+ 58,519	189,488	251,716	+ 62,228
Copper, wrought, of other sorts... „	1,661	773	3,808	1,367	11,027	4,528	− 6,499	25,812	7,900	− 7,912
Brass of all sorts ... ... „	2,011	3,075	5,431	5,084	11,125	14,347	+ 3,222	29,733	24,963	− 4,770
Lead, Pig, Rolled, Sheet, Piping, Tubing, and Lead Shot tons	1,959	2,345	2,968	4,039	42,153	51,077	+ 8,924	63,696	88,167	+ 24,471
Lead, Ore, Lead, Red and White, and Litharge of Lead ... „	667	452	1,068	700	15,159	9,718	− 5,441	24,702	16,121	− 8,581
Tin, unwrought ... ...cwt.	8,116	5,394	11,961	9,906	50,086	30,826	− 19,260	72,578	56,877	− 15,701
Tin Plates ... ... „	83,838	85,152	138,516	145,904	99,040	98,260	− 780	163,323	169,415	+ 6,092
Zinc or Spelter, wrought or unwrought ... ... „	11,735	6,303	14,536	11,389	10,727	6,369	− 4,358	13,796	11,779	− 2,017
Salt ... ...tons	42,214	34,211	77,518	54,728	21,277	16,108	− 5,169	38,394	26,061	− 12,333
Telegraphic Wire and Apparatus ... ... value in £	—	—	—	—	19,586	23,501	+ 3,915	63,731	26,228	− 37,503
				£	1,337,363	1,632,561	+ 295,198	2,556,232	2,897,582	+ 341,350

M. MOISSENET ON THE CORNISH METHODS OF DRAWING STUFF.

De l'Extraction dans les Mines du Cornwall. Puits inclinés et coudés. Par M. L. Moissenet, Ingenieur des Mines. Paris: Dunod, Quai des Augustins, No. 49.

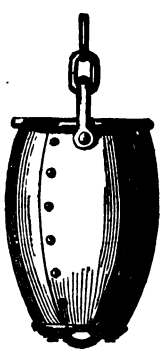
(*Continued from page* 230.)

§ 3. *Description and Cost of the Apparatus.*

I. SHAFTS.—The shafts sunk at present are generally larger and more regular than the old crooked shafts. When it is necessary to resume the use of one of these latter, it is usually improved by cutting down, by which it is not only enlarged in size, but its variations of inclination are reduced as much as possible. The dimensions adopted for a shaft depend principally upon the objects for which it is intended: whether for a drawing shaft, used exclusively for the drawing of stuff; or for an engine-shaft, used primarily for pumping, but having a distinct portion cased off for the drawing. The drawing shafts are from 5′ to 7′ long (following the run of the lode) and about 4′ wide. The following are the dimensions of certain engine-shafts:—

10′ by 5′.
11′ „ 5′, Wendron Consols.
12′ by 7′, Stray Park.
12′ „ {7′ / 8′} United Mines.

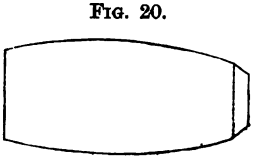
FIG. 19.



The portion of the shaft cased off for drawing includes its whole width and from 5′ to 7′ of its length. When kibbles are used, to meet the danger of breakages and falling away, the casing is obliged to be made of strong deal planking 5″ or 6″ thick; but with skips the thickness of the planking need not exceed 1½″, nailed on cross pieces 5″ by 8″, which are about 6′ apart.

In the majority of tin mines, and in many copper mines, the lode and the capels are harder than the country, in which case the shafts stand perfectly firm by themselves, and their walls afford a regularly inclined surface. In soft killas and granite, particularly in the portions near the surface, the shafts are timbered, and if kibbles are used the pieces are protected with a lining of planks.

FIG. 20.



II. KIBBLES.—A kibble of ordinary size is shown in Fig. 19, which represents a *six-plate kibble* as used at Dolcoath in 1858. Fig. 20 shows one of the plates used in making such a kibble: the plates are of the best hammered iron, and are joined together by 14 rivets, 6 on each side and 2 at the bottom, the kibble being finished off as shown in Fig. 19, with a strong bow rivetted on two opposite plates, and a small eye at the bottom. The dimensions of such a plate are as follows:—

Length		3′ 3″
Thickness		1¼″
Width	At the top	14½″
	In the centre	15½″
	At 2″ from the bottom	12″
	At the bottom	8″

The bottom plate is 15″ in diameter and 3⅛″ thick. The rivets are 1¼″, of which there are 50, besides those of the bow. The measurement of the kibble is therefore about :—

Height		34″
Cubic contents		7 cubic feet
Diameter	At the top	22″
	At the belly	24″
	At the bottom	15″

Its weight is estimated at :—

The six plates and bottom plate	2½ cwts.
Accessories (⅛ of the weight of the plates)	⅛ „
Total weight	3 cwts.

A kibble of this size will hold about 7 cwts. of tin ore.

At Dolcoath a larger—a seven-plate—kibble was formerly used, weighing 3½ cwts., and holding 10 cwts. of work. At Drakewalls the drawing is effected from a shallow depth with the largest kibbles I observed in the county. Their dimensions were : diameter 33″ and height 3′. They weighed 4½ cwts., and contained about 15 cwts. of work. When the size of the shaft allows of it, it is desirable to augment the diameter of the kibble with respect to its height ; the Dolcoath kibble figured may be considered as rather a narrow type.

Weight of the Kibble and of its Load.—I have summed up in the following table the data which I have collected on this subject with regard to the principal kibbles in use : the information is, of course, not all equally reliable.

WEIGHT OF KIBBLE AND OF ITS LOAD.

Mines.	*a.* Weight of Kibble.	*b.* Possible Weight of Load.	*c.* Ratio $\frac{a}{b} \times 100$.	*d.* Weight of full Kibble.	*e.* Estimated Weight of Load of 100 Kibbles.	*f.* Mean Weight of Load deduced from *e*.
	Cwts.	Cwts.		Cwts.	Tons.	Cwts.
Dolcoath No. 1	3	7	43	10	30 to 35	6 to 7
Dolcoath No. 2	3½	10	35	13½	„	„
Drakewalls ..	4½	15	30	19½	65	13
Botallack ..	3	5	60	8	25	5
Fowey Consols ..	3	9	38	12½	30 to 35	6 to 7
	Kibbles for horse-whims.					
Fowey Consols ..	1¾	4	44	5¾	12½ to 15	2½ to 3
Wendron ..	1¾					
North Downs ..	1	2	50	3	10	2

Column *b* shows the weight of work that *can* be loaded in each kibble, and *e* the weight of the loads of 100 kibbles, as they are usually estimated in the ordinary course of working. The last column, *f*, founded on this average, shows a less weight than that taken for each kibble separately. Under ordinary conditions we may consider that the kibble weighing 3 cwts. will contain about 6 cwts. of stuff ; and that the horse-whim kibble, weighing from 1¾ cwts. to 1½ cwts., will contain about 2½ cwts. The ratio *c* may be estimated to average 50 per cent., but is reduced to 40 for the larger, and particularly the wider, kibbles.

Cost of Kibbles.—The Cornish founders not only sell the kibble-plates,

but also the finished kibbles. They are sold by the cwt. at the same rate as boiler-plates. There is a difference of about 4*s.* per cwt. between the price of the kibble-plates and the finished kibble, which represents the labour of making them and the profit of the founder. Mines which possess a well-fitted-up forge have a considerable advantage in being able to make and repair their own kibbles. The following were the rates for kibbles and plates from 1855 to 1857, and also in 1858 :—

	From 1855 to 1857.	1858.
	s. *s.* *d.*	*s.*
Finished kibbles ..	20 to 21 0 per cwt.	19 per cwt.
Hammered plates ..	16 „ 17 0 „	15 „
Rivet iron	14 „ 14 6 „	14 „

The Dolcoath kibble, finished, weighing 3 cwts., would thus be purchased for about 3*l.* It is calculated that on the mine a good smith and his assistant would make such a kibble in one day, which would thus cost for workmanship, including the coal consumed, about 5*s.*, and the total expense of which would consequently come to about 52*s.*

Wear and Duration of Kibbles.—As an example of the wear and duration of kibbles, I may quote the following particulars furnished me by Captain Charles Thomas, respecting the working of the two principal shafts at Dolcoath in 1855 :—

	£	*s.*
Bought :—		
Kibble-plates, 7 tons 15 cwts. at 16*s.* 6*d.* per cwt. ..	128	5
Iron rivets, bows, bottoms, &c., paid to smiths for making and repairs	100	0
	228	5
Sold :—		
Old kibbles	47	18
Cost of kibbles at the two shafts	180	7

Not having any particulars as to the proportion of the repairs it will suffice to observe that the plates consumed were *equivalent* to 62 new kibbles.

If we assume that the rivets, bows, &c. weigh ⅓ of the weight of the plates, and that the old iron was sold at 6*s.* per cwt., we find that 14 per cent. of the body of the kibble was really *consumed* by the friction. A quantity of iron, equivalent to 31 kibbles was consumed per shaft in 300 working days ; that is to say, each kibble, even with repairs, only did work for 10 or 12 days of 24 hours. From the data given further on it will be seen that each kibble approximately performs a mean journey of upwards of 600 miles, and that its loss from wear and tear is under 50 lbs. We must not, however, attach an exaggerated importance to these figures, or take them for more than a simple indication. In fact, one of the greatest causes of wear and tear is the breakage of the chains, and the falling away of the kibbles ; and this accident may occur with a new kibble, which is then entirely destroyed. This explains the small loss of weight on the old kibbles from wear and tear.

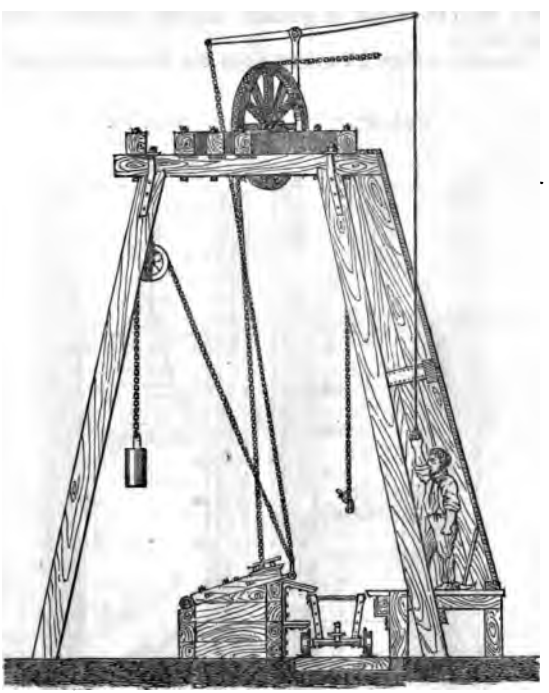
In 1858 the drawing at Dolcoath was effected by five engines—two working day and night, one about half the time, a fourth about a third of the time, and a fifth only rarely—representing together three shafts, from which stuff was continually being drawn. From seven to eight kibbles were made monthly, that is, ninety per year, or thirty per shaft per year. At Botallack with four shafts, working intermittently, they calculated that eighteen kibbles per shaft were used annually.

Underground Filling-places (*Plats*).—At each level the rock is excavated so as to leave a sufficient space for the deposition and filling of the stuff, called the *plat*. The forms and dimensions of plats vary considerably. The system of tribute, which makes it necessary for the stuff of the various pares to be kept separate, creates a certain amount of complication at the filling places, and care and watchfulness are required to prevent fraud.

The kibble comes down to the foot of the filler, sliding on a swing gate, that has an inclination of about 60°. This is made of 3″ plank bolted to cross pieces, and is supported at the bottom by the plat, and at the top by the opposite side of the shaft. The filler fills the kibble, and then gives the signal to the engine-man to wind up.

Landing Places.—The arrangements at the surface are rather more complicated. Fig. 21 shows one of the landing-places at Carn Brea mine, on an elevation at right angles to the length of the shaft, and will give an idea of the arrangements at the mouth of a shaft where the drawing is by kibbles.

FIG. 21.



The lander having brought his empty waggon to the side of the shaft, waits (as shown in the sketch) the arrival of the kibble. When this is approaching the surface he raises the cover of the shaft (which turns on a hinge, and is balanced by the weight shown in the sketch) by means of the lever connected with the handle he holds. When the kibble is clear of the shaft he lets go the handle, and the cover again closes. He then takes the pincers (shown in the sketch) by which he catches the eye at the bottom of the kibble. The chain is now slacked by the engine-driver, and

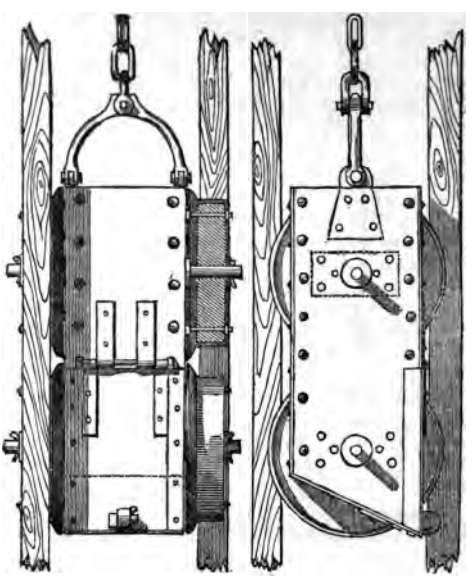
the result is that the kibble is turned over, and its contents discharged into the waggon. The cover of the shaft is now opened, and the lander by a peculiar movement again throws the kibble into the shaft, after which the cover is again finally lowered.

Some shafts are also furnished with *catches* for retaining the chain in case of breakage. Breakages generally take place while the kibble is being wound up (and this is the only case where the catches are used); and as the shafts are sometimes at a considerable distance from the engine and from each other, the chain is carried from one to the other on pulleys, supported on puppet-heads. As the greatest amount of tension is necessarily near the engine, the chain more frequently breaks near the surface, in which case only are the catches of any use. They move on a hinge, and are so arranged that while they allow the chain to pass upwards they catch it as soon as it begins to descend, which of course would occur in the case of a breakage at the surface.

III. SKIPS.—In studying the construction of skips it is well to consider the body separately from the wheels and friction-bars or rubbers, which latter depend upon the mode of guidage adopted, resulting from the condition of the shafts.

Body of the Skip.—Figs. 22 and 23 show the form of skip used at Levant

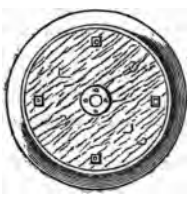
FIG. 22. FIG. 23.

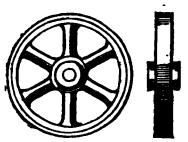


mine. The faces and sides are united-by an angle of iron 2½″ wide, made by bending the faces at a right angle, and rivetting the sides thereon (with rivets 7″ apart). The iron plate in front, which acts as a door, has two rectangular borders 2½″ wide, strengthened by rivetted bands 2½″ wide. It is closed by a catch-pin, which can be driven back or forward by a hammer. A preferable mode of closing is shown in Fig. 24, which is that

adopted at Wheal Buller. A vertical fork of square bar-iron, is kept in its place by a kind of revolving handle fixed above it, which by one blow of the pick the lander turns, while with the other he raises the fork.

FIG. 27. FIG. 26.





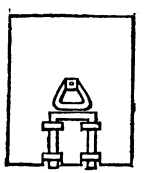


FIG. 25. FIG. 24.

Returning to the Levant skip. The bottom is strengthened on its line of contact with the landing place by a band of iron 4″ wide by 1½″ thick. The eyes to which the bow of the skip is attached, are 9″ wide at the base, and are bolted to the side of the skip by four rivets. The form of the bow here is oval, but it is also often rectangular, so as to leave the opening of the skip completely free for filling. Each axle is kept in place by an iron plate (15″ by 7″) attached by five rivets to the interior of the side of the kibble. The diameters of the axles are, in this case, 1½″. The total number of rivets in the skip is 114, large and small.

I have arranged in the following table the principal relative forms and dimensions of several skips at various mines :—

DIMENSIONS AND MEAN WEIGHT OF SKIPS AND OF THEIR LOADS.

Name of Mine	United Mines	Wheal Buller Hocking's shaft	Stray Park	Carnbrea	Levant
Mode of Guidage	Vertical shaft Friction bars	Wheels and 4 guides			Wheels and 8 guides
Body — Width between guides	0′ 24″	0′ 20″	0′ 17″	0′ 19″	0′ 19″
Body — Depth	0′ 24″	0′ 26″	0′ 24″	0′ 22″	0′ 21″
Body — Height in front ...	4′	4′	4′ 6″	4′ 4″	4′ 9″
Body — Mean height	3′ 6″	3′ 6″	4′ ¾″	4′ 0″	4′ 5″
Thickness of the plate — of the faces ...	—	0′ ¼″	0′ ¼″	0′ ¼″	0′ ¼″
Thickness of the plate — of the bottom	—	0′ ⅜″	0′ ¼″	0′ ¼″	0′ ⅜″
Wheals — Diameter	No wheels	0′ 20″	0′ 18″	0′ 14″	0′ 22½″
Wheals — Depth	No wheels	0′ 2½″	—	0′ 3″	0′ 4″
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Weight — of skip complete ...	6½	8	9½	6	8
Weight — of the mean load ...	12½	12½	11½	11½	11½
Weight — of skip loaded ...	19	20½	20⅝	17½	19½
c. Ratio of the weight of the skip to that of the load per 100	52	64	84	53	71
Capacity of body in cubic feet	12½	12½	11½	11½	11½

I must here make the same reserve, as to the weight of the load, as in the case of kibbles, for the variation is sometimes very great. With rich

ores, the skip of 11½ cubic feet will carry a load of from 17 cwt. to 18 cwt.; and that of 12¾ cubic feet, one of as much as 20 or 21 cwt. These figures are those that are usually given to visitors, but they do not truly represent the average normal weight. Captain Tonkin thinks that a skip capable of carrying 12 cwts. should not weigh more than 8 or 9 cwt. I think that most frequently the ratio *c* will be about 70, and will only fall to the minimum of 50 with the very best types—and this ratio will also of course vary with the kind of wheels adopted.

Guidage.—The modes adopted for guiding skips depend on the conditions of the shafts, and even beyond this the details are varied according to the notions of each engineer; it will here suffice, however, to give a few instances of the most usual modes.

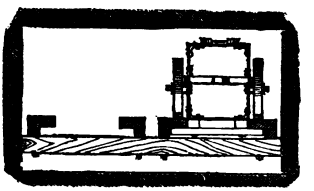
At the United Mines, the shaft being vertical, the skip has no wheels. The wooden bars, or rubbers, which are bolted horizontally on the back of the skip—one near the bottom, and two (close together) near the top—extend about 4″ beyond it into vertical grooves, which latter are bolted to the casing that separates the drawing compartment from that of the man-engine. At Wheal Buller the shaft is vertical to the adit (40 fathoms) below which it underlies north with the lode at the rate of 9″ to the fathom. The system of guidage adopted is shown by Figs. 28 and 29. The body of

FIG. 28.

the skip has two longitudinal vertical pieces of wood bolted to it, to guard against the zig-zag movement, upon which two iron cross-bars are bolted at

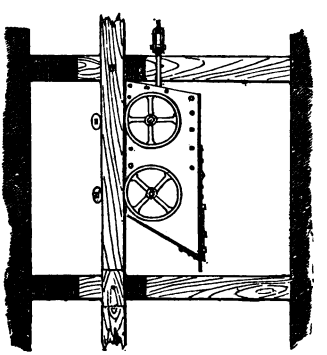
the level of the axles; and the guides form a groove in which the whole of this glides easily. Each guide comprises two pieces of wood, placed one on the other, forming a groove 8″ wide and 3″ deep. These guides are supported by transverse stay-pieces 6″ by 7″, to which they are secured by 1½″ bolts; with a single road, the space between the cross-pieces is 9′, but with a double road it is reduced to 6′. The space between the guides, measuring from one groove to the other, is 20″. The wheels (see Fig. 25, p. 277) are of cast-iron, bound with wrought-iron, but their form is heavy and very inferior to that of Carnbrea, Fig. 26. This Carnbrea wheel, the dimensions of which are sufficiently shown by the figure, weighs 28lbs., or 1 cwt. for the set for a skip. By thus applying himself to lighten the accessory parts of the skip, Capt. Daw has succeeded in constructing one of the most advantageous in use, since the total weight is only 6 cwts., while it carries a load of as much as from 12 to 13 cwts. of heavy Barncoose work.

Fig 29.



In Stray Park, which is an old and deep mine adjoining Dolcoath on the west, the shaft is vertical to 100 fms. from surface, below which it inclines regularly 15″ per fm. The skip is heavy and ill-suited, on account of the small space disposable; but the arrangement of the guides, as shown in Fig. 30, is worth describing. They measure 5″ by 6″, and have been sawn from pieces of Longsound 30′ to 40′ long—their average length is 36′. Where they are joined together there is always a stay, and the same bolt holds them all together. There are three stays at the same level, and the distance between each group is about 6′: they are all 8″ deep, and that which supports the casing is 5″ wide, while the others are but 3″. It will be remarked that, to prevent the tearing of the guides in the vertical portion of the shaft, the rubbers are provided with heads in the form of a double-pointed hammer.

Fig. 30.



The modes of guidage described (by wheels and rubbers) are those most in use, because they are most suitable to the greater number of shafts—vertical at first, and then inclining at various angles, but always in the same direction. The modes of guidage, the description of which follow, are also suitable to these conditions; but they are likewise applicable to the more complex conditions, where the inclination of the shaft not only varies in amount, but also in direction.

At Levant the shaft, which is 6′ by 4′, first inclines to the north-east, then to the south-east, and has also four other elbows. The guides, eight in number, are 4½″ square, and the four guides of each road are 2′ apart each way. The arrangements are shown in Figs. 22 and 23 (*ante* page 276) and Fig. 27 (*ante* page 277). The wheel is made up of a plate of wrought-iron 1½″ thick and 27″ in diameter, slightly convexed towards the circumference. On this a disc of wood, 4″ thick and 22″ in diameter, is fastened by four bolts, round which is put a tire of wrought-iron 1¼″ thick. The flanges have thus a depth of 2½″; and the exterior diameter of the tire being 22½″, there remains 1½″ for the play of the wheels in the guides.

Owing to the use of wood, this wheel at Levant, although large, is not excessively heavy; but then it wears out rapidly.

At Devon Consols the skips in one of the shafts are guided in a similar manner, the guides being likewise 2′ apart, but they are faced with light iron rails, and the wheels of the skip are like those of a waggon.

Instead of four wheels and eight guides, some mines have adopted, as I have stated, four guides and eight wheels. The principal objection to this arrangement is that it makes the skip heavier, and also more complicated by having eight axles to be greased and kept in repair.

At Providence Mines the additional weight has been compensated for by reducing the thickness of the plates to $\frac{3}{16}$″ for the sides, and $\frac{5}{8}$″ for the bottom.

The employment of rails on the guides is necessary when the lode underlies 40° or upwards, in which case the skip-road approaches to an inclined plane. Thus at West Seton where the Old North lode underlies north 5′ in a fathom, the rails have the form of a Ω; lower down, where the lode only underlies 2′ 6″ per fathom, only bars of flat iron are used.

Comparison between the Systems of Guidage.—In comparing the systems of guidage with respect to the friction and the weight of the skip, it will be necessary to take into consideration the configuration of the shafts; but we shall leave out of the question entirely vertical shafts and those approaching to inclined planes, and confine ourselves to the more general cases of shafts vertical in the first place and then inclined at various angles of dip, ranging from 65° to 70°.

In the vertical portion of the transit, wheels are positively injurious, (except there are eight of them) for, taking the case of Levant, a large wheel oscillating between two guides, will continually get a contrary rotation, causing friction and wear and tear. With wheels and rubbers this still exists, and the heads with which the rubbers are provided at Stray Park (Fig. 30) are not at all too much to modify the tearing of the wood at the back of the guides. This arrangement, however, has the disadvantage of giving rise to lateral friction throughout the whole depth, which would be avoided if the plane-faced wheels were replaced by waggon wheels—the guides being provided with light rails. In such a case the weight of the skip can be reduced by adopting wheels of a less diameter: thus with the decided incline there is in Wheal Buller, the wheels could be advantageously reduced one-half.

Cost and Duration of Skips.—According to their resources, the mines either purchase skips ready completed, or make them in their own forges, In 1858, Botallack mine purchased two skips at St. Just, similar to those of Levant before described, at the following rate: two skips weighing 13 cwt. 1 qr. 26 lbs. @ 26*s.* per cwt. 17*l.* 10*s.* 6*d.*; or 8*l.* 15*s.* 3*d.* per skip. Mr. J. Hocking (1862) estimates the cost of the two skips at Levant at 14*l.* 8*s.*, or 7*l.* 4*s.* per skip.

Plates for skips or waggons are sold, according to quality, at from 14*s.* to 17*s.* per cwt.; to which the founders seem to add about 4*s.* for making and profit: the making at the mine ought not to exceed 2*s.* 6*d.* per cwt. The body of a skip, weighing 6 cwt., would thus cost from 6*l.* to 6*l.* 6*s.* As to the wheels, they cost from 9*d.* to 1*s.* per lb.; but if we adopt the light wheels like those described as in use at Carnbrea, the cost of the four will not exceed from 4*l.* 4*s.* to 5*l.* 14*s.* Thus a skip complete weighing 7 cwt., capable of containing a load of 12 cwt., will not cost less than 10*l.*

The duration of skips, like that of kibbles, is a good deal dependent on accidents of breakage in the shaft. One pair is always kept in reserve for each shaft; and if the drawing is continuous we may estimate that two pair of skips will be used per shaft per year—if not, one pair will suffice, The duration of the wheels is extremely variable: at Levant, they estimate to use eighteen wheels per year.

Some mines have adopted Bennett's Safety Skip, furnished with springs

and catches—which, being almost secure from accident, ought to last more than a year.

Steel skips, such as the two purchased by Botallack in 1858, may also be adopted with advantage in respect of weight. The body weighs 4 cwt. 8 lbs., and costs, at 56*s.* per cwt., 11*l.* 8*s.* A steel skip, with iron wheels complete, to carry a mean load of 11½ cwt., would not weigh more than 5¼ cwt., which would reduce the ratio *c* to 45.

Cost of Guidage.—As examples of the consumption and cost of wood for guides, I shall take the cases of Stray Park and Wheal Buller—referring, for the dimensions, to the particulars already given.

At Stray Park the consumption and cost per 100 fms. for two roads, amounted to :—

	£	*s.*	*d.*	£	*s.*	*d.*
Four guides :—1,131 ft. of Longsound @ 9*d.*	42	8	3			
(Producing cut out, 514 cubic ft.) Sawing 5,661 sq. ft. @ 2*s.* 2*d.* per 100	6	2	8			
				48	10	11
Transverse stays :—458¾ ft., ready cut, at from 1*s.* 3*d.* to 1*s.* 6*d.* ..				34	7	6
Total quantity of timber for guides and stays per 100 fms., 972⅜ cubic ft., costing				82	18	5

or nearly 16*s.* 8*d.* per running fathom of the shaft. At Wheal Buller the cost was only 12*s.* 6*d.* per running fathom.

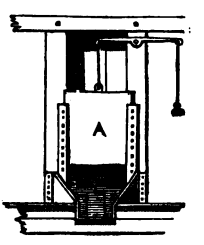
Shafts with eight guides, like those of Levant and Botallack, take more wood than such a one as Stray Park, but the guides being smaller the cost does not exceed 18*s.* 6*d.* per running fathom.

To the cost of the wood must be added that of the bolts and the carpenters' wages. The latter item necessarily varies with the state of the shaft, and it is one difficult to estimate, there being no very regular accounts kept. The following particulars of the cost per running fathom at Stray Park and Wheal Buller, are little more than estimates :—

	Stray Park.			Wheal Buller.		
	£	*s.*	*d.*	£	*s.*	*d.*
Timber	0	16	8	0	12	6
Bolts	0	0	10	0	0	9
Labour	0	6	6	0	6	0
	1	4	0	0	19	3

In 1858, 144 fms. of guides were put in at Great Wheal Busy, under what circumstances I was unable accurately to ascertain, which cost, with skips, 250*l.*, or nearly 1*l.* 15*s.* per fathom of shaft. The total cost of guidage for a shaft 220 fathoms deep may be estimated at from 250*l.* to 350*l.*, according to the system adopted, exclusive of timbering and casing.

FIG 31.

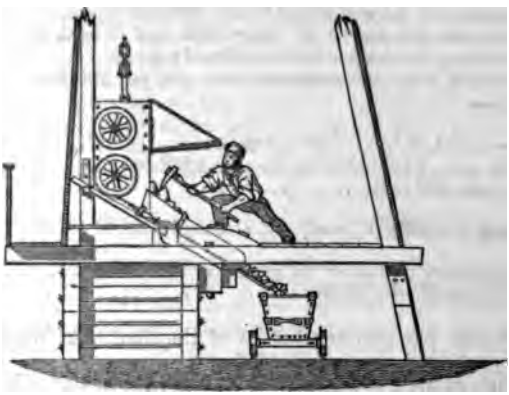


Plats for Skips.—The skip being so constructed that it cannot leave the guides, it is merely stopped at the level of each plat, where it is loaded by the fillers. Fig. 28 (*ante* p. 278) and Fig. 31, show the arrangements of a plat at Wheal Buller ; where, the filling of the work, which has a soft gangue of friable chlorite and fluor spar, and consequently yields but few large rocks, is facilitated by a hopper with the trap A. The bottom of the skip is brought to rest on the bars, the trap is raised, and the filler has

only to guide the stuff into the skip, aided by the arrangement shown in the figure. This mode of filling, which is imitated from the arrangements of the "passes" above the levels, is certainly advantageous, when the nature of the work is such as to allow of its adoption.

Landing Places.—Fig. 32 represents a landing-place drawn from a sketch

FIG. 32.



taken at Hocking's shaft at Wheal Buller, which shows the lander in the act of emptying the skip into the waggon beneath. The skip is supported by two iron bars (resting exteriorly on the guides), which form the head of the inclined plane, down which the stuff runs into the waggon. This inclined plane is of strong sheet iron; but the manipulation of the apparatus is sufficiently obvious from the sketch to make any detailed explanation unnecessary.

(*To be continued.*)

THE *REVUE UNIVERSELLE.*

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics, des Sciences et des Arts, appliqués à l'Industrie, sous la direction de M. Ch. de Cuyper, Professeur Ordinaire à la Faculté des Sciences de l'Université de Liége. Sixth year, 6th livraison, November and December, 1862; and seventh year, 1st livraison, January and February, 1863. Paris and Liége, E. Noblet, à Paris, rue Jacob, No. 20.

These numbers of this well-known periodical contain many important papers on matters relating to mining and metallurgy. In the November-December number, the first article is a very valuable review on that portion of the International Exhibition, 1862, relating to mines and works in metal which, as the review of a foreigner, may be read with interest and instruction. The second paper is a continuation of M. Dwelshauvers' review on the mechanical department of the Exhibition. This number also contains M. Ed. Grateau's *Revue Semestrielle* on Mining and Metallurgy.

The first livraison for 1863 has articles on the Metallurgy of Lead, by M. Michel Cahen; on the Manufacture of Sheet Iron, by M. Oscar Ronge; and the continuation of M. Bède's memoir on the Theory of the Steam Engine (particularly of the steam-case). All these papers are of considerable interest, and are followed by the usual *Bulletin* and Bibliography.

DR. STERRY HUNT ON BITUMENS AND BITUMINOUS SHALES.

THE last number of *Silliman's American Journal* contains an important paper by Dr. Sterry Hunt entitled "Contributions to the Chemical and Geological History of Bitumens, and of Pyroschists or Bituminous Shales."

Under the general name of bitumen are included both the liquid forms (petroleum and naphtha), and the solid varieties (asphalt or mineral pitch) —the characters of fusibility and solubility in liquids like benzole and sulphuret of carbon serving to distinguish the solid bitumens from coal and certain other bodies. The chemical composition of these matters varies considerably, early analyses showing a composition of $C_n H_n$, while later investigations show a slight excess of hydrogen, or a formula of $C_n H_{n+2}$; but the first formula may be adopted or approximately true for liquid bitumens.

The chemical changes that convert woody tissue into peat, lignite and bituminous coal are well known. The abstraction of variable proportions of water and marsh gas may give rise either to hydrocarbons like $C_{24} H_8$ (the basis of bituminous coals) to $C_{24} H_{16}$ (representing many asphalts) or $C_{24} H_{24}$, which represents petroleum. The removal of a further amount of marsh gas, $C_2 H_4$, may even convert bituminous coal into anthracite—a conversion which although it may have been effected by heat has often been the result of decompositions at an ordinary temperature. Thus anthracite (or nearly pure carbon) on the one hand, and petroleum (or carbon with a maximum of hydrogen) on the other, represent the two extremes of the process, of which bituminous coals and asphalts are intermediate terms.

Petroleum impregnates certain rocks from which it flows spontaneously, and the solid forms of bitumen are often disseminated throughout limestones and sandstones. To such rocks the term bituminous is correctly applied; but it is often inappropriately given to substances like coal and certain combustible schists, which contain little or no bitumen, but yield, by destructive distillation, volatile hydrocarbons. As however lignite, peat, and even wood yields analogous products, the epithet "bituminous" applied to hydrogenous coals, and combustible schists, raises a false distinction and perpetuates an error, which Dr. Hunt proposes to meet by distinguishing those so called bituminous schists (the *brandschiefer* of the Germans) by the name of *pyroschists*.*

Several instances are given of the occurrence of pyroschists, which not improbably derived their organic matter from the remains existing in the rocks,—either vegetable, as is doubtlessly the case in the abundant pyroschists of the coal period,—or animal as in those of the Lower Silurian Utica formation, the chief organic remains of which are Graptolites with a few Brachiopods and Crustaceans.

Although solid asphalts have in most cases been formed directly from organic matters by a process analogous to that which yields coal and petroleum, this latter body may gradually undergo an oxydizing process which at last converts the liquid bitumen into substances, having the characters of asphalt, of coal, and even of anthracite. Several instances are given of this, and the view is generally confirmed by the examination of a bitumen which appears to be in the very act of changing, in a bed of fossil corals, impregnated with petroleum, in the Devonian limestones of Canada.

Turning to the distribution of petroleum in the Paleozoic rocks of North America, he points out that it occurs in two distinct horizons in the

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* Compare Prof. Ansted's observations on this term, *Mining and Smelting Magazine*, Vol. II, p. 353 (December, 1862).—ED. M. & S. M.

New York series; one Lower Silurian and the other Lower Devonian, but both occuring in rocks of the same mineral character.. At the base of this series are the silicious sandstones of the Postdam formation; next the Calciferous sand-rock, for the most part a dolomite; next the Chazy limestone forming a transition from the dolomites beneath, to the overlying pure limestone of the Trenton group—where, for the first time, we meet with petroleum, forming the first zone. To these limestones succeed, in ascending order, the pyroschists of the Utica formation; followed by the shales of the Hudson River group, which terminate the Lower Silurian system. This succession of strata taken lithologically, is reproduced with a remarkable parallelism, in the Middle Silurian, the Upper Silurian, and the Lower Devonian rocks that succeed; each series being characterized by a successive development of silicious strata, dolomites, pure limestones, and pyroschists—the limestones being the petroleum producing rock. It is in the Corniferous formation, or the Lower Devonian limestone, however, that the greatest amount of petroleum occurs, forming the second zone; although it is sometimes found in other strata—particularly above this, in which case it is more than probable that the Corniferous limestone is its source, as it is undoubtedly that of the petroleum of Western Canada.

The facts observed connected with the occurrence of petroleum in this formation appear to show that it (or the substance that has given rise to it), was deposited in the beds in which it is now found, at the formation of the rock. "We may suppose," says Dr. Hunt, "in these oil-bearing beds an accumulation of organic matters, whose decomposition, in the midst of a marine calcareous deposit, has resulted in their complete transformation into petroleum . . . . . The same observations apply to the petroleum of the Trenton limestone; and if it shall hereafter be shown that the source of petroleum (as distinguished from asphalt) in other regions, is to be found in marine fossiliferous limestones, a step will have been made towards a knowledge of the chemical conditions necessary to its formation."

The natural oil springs of Canada are on the outcrop of the Corniferous limestone, or of the overlying Hamilton shales, along the line of a broad and low east and west anticlinal. The principal wells occur at Enniskillen, where the Corniferous limestone is overlaid by about 200 ft. of marls and soft shales of the Hamilton formation. Here the thickened petroleum forms layers of considerable extent at the surface and around the roots of growing trees: two of these have an area of more than 2 acres, with a thickness varying from a few inches to 2 ft. In sinking a well in the vicinity there was also found, beneath a depth of 10 ft. of clay, and reposing on 4 ft. of gravel, a similar layer of from 2 to 4 in. thick. Generally, on sinking wells in this district, there is usually found, reposing immediately on the shales, a layer of coarse gravel, holding large quantities of petroleum that has accumulated under the clays, which form the oil of the so-called "surface wells." It is darker and thicker than that obtained directly from the rock below—on boring which fissures or seams are met with, from which the petroleum issues in abundance, sometimes attaining the surface, and even rising above it, and constituting the "flowing wells." These oil-bearing veins are met with at depths varying from 40 ft. to 100 and 200 ft., and adjacent borings seem sometimes to be connected and to effect each others supply. The deepest in the region was estimated to yield, when first opened, 2,000 gallons per twenty-four hours, and at present, when allowed to flow for some time, the supply is found to fail in many neighbouring shallower wells. On the whole the facts observed seem to show that these fissures are running obliquely downwards to the great reservoir of petroleum, which is probably in the underlying Corniferous limestone.

The accumulation of the petroleum along lines of uplift, and its escape through the fissures accompanying this disturbance, must evidently date from a remote geological epoch. Porous beds have served as reservoirs in

which the oil has accumulated, while argillaceous and nearly impervious strata (like the marls of the Hamilton group), have in a great measure prevented its escape. Hence it would appear that the Devonian sandstones of Pennsylvania and north-eastern Ohio are filled with oil, which has risen from the limestone beneath, while, over a great portion of western Canada, this limestone was ages ago denuded, and has lost the greater part of its petroleum.

In conclusion, Dr. Hunt urges on geologists the importance of determining, as far as possible, the nature and the age of the rock formations to which the petroleum of different regions is indigenous, carefully distinguishing those cases in which its occurrence is evidently the result of a secondary process. As an instance of this, it is most desirable to determine whether the oil wells of the Carboniferous rocks of Ohio and Virginia derive their supplies, like those of Pennsylvania, from the Lower Devonian limestone, or whether there exists, in the carboniferous system, a third oil-bearing horizon, analogous to those of the Trenton (Lower Silurian) and Corniferous (Lower Devonian) limestones.

THE MANUFACTURE OF ARMOUR PLATES.

On the 9th of April, the Lords of the Admiralty, with a distinguished official, scientific, and practical circle, visited Mr. Brown's Atlas Works in Sheffield, to witness the inauguration of the New Mills, erected specially for the manufacture of armour-plates, which were that day used for the first time.

The manufacture of armour-plates has within the last few months been in a fluctuating and uncertain state. The experiments at Shoeburyness at first gave very varied results, and it was not until after some time that they at last pointed almost decisively in favour of rolled plates instead of hammered. The fibre in the former was found to be stronger, the texture of the metal in every part more even, and the average of perfect soundness throughout altogether of a higher standard than could be relied on from the work of the steam hammer. Still there seemed a great difficulty in obtaining any large supply of really good plates, even of the *minimum* thickness of 4½ in. We hear constantly of the armour-clads on the other side of the Atlantic being coated with 12 and even 15-in. plates of iron; but these plates are built up by bolting together one-inch or two-inch plates till whatever thickness is required by the Government is attained, but such a built-up plate of 12 in. has scarcely the resistance that belongs to a solid one of four.

Most of our readers will recollect an armour-plate from the Atlas Works shown in the eastern annexe of the Exhibition last year, which was 22 ft. long and 4 ft. wide. It serves well to illustrate the strides with which the new manufacture has advanced since then, when we state that on the 9th, a plate of upwards of 40 ft. long, 4 ft. wide. and 4½ in. thick, was rolled with perfect ease and success in the presence of the visitors. It is only a few months since some 7½ in. plates from the Atlas Works were tried at Shoeburyness, and proved that plates even of this great thickness could be made with the most perfect certainty. Yet on the 9th, a glowing mass of almost molten iron, weighing more than 20 tons, was rolled into an armour-plate 19 ft. long, 3 ft. 9 in. broad, and 12 in. in thickness.

Though not the first, yet by far the most important process which their Lordships were shown, was the operation of rolling the great plate—by far the largest single plate that has ever yet been rolled. This took place in the New Mills, where great ranges of furnaces have been erected, with their mouths opening on the iron tramway which leads direct to the double rollers through which the plate passes. These rolls have a first foundation

of no less than 60 tons of solid iron, resting on masonry carried far below the earth. The rolls themselves are 32 in. in diameter and 8 ft. wide, and are turned by an engine of 400-horse power. A powerful screw, applying its force through compound levers, allows the distance between the rollers to be adjusted to the fraction of an inch, so that the plate which on its first rolling is forced through an interval of, for instance, 12 in. apart, is on its next wound through one of 10, next through one of 8, and so on till the required thickness has been carefully and equally attained by compression through every part of the metal.

When the enormous mass of iron to be rolled was first taken from the heating-furnace, and brought to the rollers, it was found that they did not bite directly the mass came to them, and when they did the engine was almost brought to a standstill by the tremendous strain upon it; but at last the soft plate yielded, and the rollers wound it slowly in, squeezing out jets of melted iron that shot about as the pile was compressed from 19 in. to 17 in. by the force of the rollers. From the time the mass had once passed through the mill, it was kept rolling backwards and forwards, the workmen sweeping from its face the scales of oxide that gathered fast upon it. With every time it was passed through, the rollers were screwed closer and closer together, till at the end of about a quarter of an hour from leaving the furnace an almost melted mass, it was passed through for the last time and came out a finished armour-plate, weighing 20 tons, 19 ft. long, nearly 4 ft. wide, and exactly 12 in. thick throughout from end to end. This is the most signal triumph that any rolling mills have yet achieved.

Other smaller plates were then rolled in a manner that proved the skill already gained in this new branch of manufacture. One plate was 17 ft. long by 4 ft. broad and 5½ in. thick; one 19 ft. long by 4½ ft. wide and 4¼ in. thick; one we have already alluded to, 41 ft. long by 3 ft. 10 in. broad and 4½ in. thick. A lesser plate was also rolled, 18 ft. long, 5 ft. wide, with a thickness of 6 in. on one edge and 3 in. on the other. The method of converting cast-iron by the Bessemer process into the tough, soft Bessemer metal, a combination of the qualities between soft steel and tough wrought iron, was next shown. In twenty minutes from the time of putting in the charge of cast-iron, it was, without any expenditure of labour, poured out into the mould an ingot of soft tough steel, weighing 3 tons.

After these processes were over, and the various planing and fitting shops had been duly examined, the visitors were entertained by Mr. Brown at a most sumptuous *déjeûner*.

NORTH OF ENGLAND INSTITUTE OF MINING ENGINEERS.

The general monthly meeting was held in the rooms of the Institute, Neville Hall, Newcastle, on Thursday, April 9th. Mr. Nicholas Wood (the President) in the chair.

The following gentlemen were elected members of the Institute:—Mr. John Nixon, East Castle Colliery, Gateshead; Mr. John Wood, Flockton Colliery, near Wakefield; and Mr. Thomas Cookson, Parkgate Colliery, near Rotherham.

The President stated that the Council had been engaged in endeavouring to make arrangements relative to the special general meeting of the Institute, to be held at the same time as the meeting of the British Association, in August. The Council would lay a special report before the members, but the substance of the arrangements were as follows:—That the rooms of the Institute would be open for the members and their friends during the meeting of the British Association; and that special meetings would be held every morning before the opening of the sections

of the British Association, so that non-resident members would thus meet the resident members, several of whom are connected with the executive of the British Association, and could receive from them all information relative to the meetings and excursions. Also, that all the papers which fall within the scope of the sections, and which may be prepared by the members of the Institute to be read at the special general meeting, and which would really include nearly all classes of papers, would be read before the sections of the British Association, and afterwards discussed at the usual general meetings of the Institute, and printed in the Transactions. If any of these papers did not fall within the scope of any of the sections, these could be read on the Saturday, after the close of the meetings and excursions of the British Association.

The President then introduced the subject of the "Safety of the Davy Lamp Gauze," to which he had briefly alluded at the last meeting. His attention had been drawn to the subject by Mr. Greenwell, who had visited a colliery where they were in the habit of heating all their lamp gauzes red-hot previously to using them, to prevent their "exploding the gas should they become red-hot in an inflammable mixture." The subject was one of very deep importance, and he (the President) had since made one or two experiments, by inserting new lamp gauzes into the interior of a short red-hot pipe, when explosions occurred from volatilisation, and subsequent inflammation of the oil attached to the gauze. He had tried, in a similar way, gauzes which had been thoroughly cleaned and brushed, and also others after having been steeped in and thoroughly washed with a strong solution of alkali, and the same results followed. It seemed to him, therefore, probable that the oil was contained in the pores of the iron itself, introduced probably in the process of wire-drawing. He thought that subject should be thoroughly investigated; several explosions had occurred where safety-lamps were in use, and which had never been satisfactorily explained. Careful experiment should be made further to prove the liability of a red-hot gauze to explode an inflammable mixture, and the circumstances under which this could occur; and if it be found that this liability really does exist, then remedial measures should at once be sought for and adopted. Some years ago he (the President) made several experiments on the safety-lamp, the results of which had appeared in their "Transactions." The gas was on several occasions exploded by putting the lamp rapidly through it, after the gauze had attained a high temperature, and it was quite possible that the explosion was caused by the co-operation and subsequent ignition of the oil attached to the gauze, and not to the passage of flame through the meshes of the gauze: it would be well if these experiments were repeated to determine this. He thought the matter might very properly be left in the hands of the "Experimental Committee," to arrange and carry out the necessary experiments; of course, any other member who might wish to be present at the experiments could attend. A resolution to this effect was then agreed to.

The discussion on Mr. Atkinson's paper, "On the Comparative Efficiency of Two Modes of Ventilating the Hibernia Colliery, in Prussia," was then opened. The President explained that the Hibernia Colliery was situated in the Ruhr Valley, in Prussia, and the seams there lay at a very great angle, and are much distorted. The inspectors of mines in Prussia had desired the proprietors of this colliery to drive an extensive level stone drift from the extreme side of the workings, so as to carry the return air into the shaft at this level, in place of bringing it down to the level of the ingate of the upcast shaft.

The discussion on the paper "On Messrs. Donnethorpe, Firth, and Hedley's Coal-cutting Machine," by Messrs. John Daglish and Lindsay Wood, then followed.

A paper on the subject of the "Ventilation of Underground Boilers," by

William Armstrong and John Daglish, was then read. In a previous paper the subject of supplying "ventilating furnaces" with intake instead of return air was brought before the institute, and instances were given where its application had been attended with marked success. Under certain circumstances, however, as where high shaft velocity obtains, there are objections to its universal introduction. These objections, however, do not apply to underground boilers; their fires must be supplied with air of a higher relative density, in order to obtain a powerful draught. Numerous experiments prove that, under the ordinary application, nearly 10,000 cubic feet of intake air are required for the efficient supply and ventilation of each boiler, distributed as follows:—2,000 cubic feet below and through the fire, 1,000 through the apertures of the fire-door, 1,000 through the coolers on either side of the boiler, and 5,000 through the boiler-house. Of these, only the first 2,000 are absolutely required at the higher density, for the purpose of inducing rapid combustion. The writers advocate placing the boiler in the return, and allowing the return current free access over and around the boiler and coolers, and confining a current of intake air by means of pipes entering below the fire, where its higher density would be required. This method is now in successful operation. In some of the larger and deeper mines, in which as many as five boilers are employed, the saving of even 5,000 cubic feet per minute per boiler, would be attended with most beneficial results to the ventilating current of the mine.

GEOLOGICAL SOCIETY OF DUBLIN.

At the meeting of this Society on the 8th April, Mr. J. B. Jukes, F.R.S., in the chair, a specimen of the sulphide of the new metal thallium was exhibited, which had been prepared from copper ore from Bonmahon, in the county Waterford, by Mr. Emerson J. Reynolds. Mr. Reynolds stated that he had been examining several Irish metallic ores for this metal, and that traces of it were to be found in some of them. The richest source which he had as yet discovered was the copper ore from Bonmahon, from about 4 lbs. of which ore the sample on the table had been prepared. Professor Haughton remarked that it appeared to him, as well as he could see by gaslight, that the ore from which it had been obtained resembled the "bell-metal" ore more than the ordinary copper ore.

Mr. Scott, one of the Honorary Secretaries, then read a paper by Dr. T. Sterry Hunt, of the Geological Survey of Canada, "On the Chemical and Mineralogical Relations of Igneous Rocks." The author stated that while engaged in the investigation of the metamorphic rocks of North America he had been led to inquire into the possibility of determining the relative ages of these rocks from considerations connected with their chemical constitution, and had published papers on the subject in "Silliman's Journal for 1858," and in the "Quarterly Journal of the London Geological Society." He said that it could not be denied that in the earlier portion of the world's history, chemical forces had been more active than they are at present, and proceeded to explain how, by the action of chemical and mechanical forces, the silico-aluminous sediments might be divided into two types. The first of these will contain a predominance of quartz and potash felspar in a finely divided condition, affording the elements from which granite, trachyte, &c., may be formed; while the second will consist mainly of clays containing a predominance of basic elements, such as alumina, lime, &c., with soda; the materials from which basic felspars, with pyroxene and hornblende may be formed, giving rise to diorites and dolerites. These groups correspond to the two classes of igneous rocks, supposed by Durocher and Bunsen to have been derived from two distinct *magmas* existing under the crust of the earth. He then

explained his views on metamorphism, showing how this cannot be considered to be solely due to the action of igneous rocks, as it is generally most developed in regions where there are no intrusive rocks. His own experiments, which have been confirmed by those of M. Daubrée, led him to the conviction that mineral springs are among the most fertile causes of metamorphic action. It will thus be seen that the mean composition of any sediments will vary, not only with their geological age, but with the number of times that their materials have been broken up and exposed to the agencies of which we have been speaking. However, it may fairly be assumed that there is a general relation between the age of the rocks and their chemical composition. The sediments belonging to the first class will contain silica, alumina, and alkalies, in proportions sufficient to form orthoclase and albite; and if these be again subjected to the action of infiltrating waters the alkalies will gradually disappear, the soda first, the potash afterwards, giving rise in the first instance to micas, which are characterised by the absence of soda, and finally to andalusite and garnet, thus leading to mica schists with free quartz. The effect of the same actions on the sediments of the second class will be to remove the alkaline element, which is here chiefly soda, and to give rise to lime-garnets, zoisite, chlorite, &c., with hornblende and olivine. The author then applied these principles to explain the differences in chemical constitution between the three great groups of metamorphic rocks which are found in Eastern North America; and in conclusion he stated that he had examined several specimens from the West of Scotland, and the eastern portion of Donegal appeared to agree with corresponding rocks in Canada. This subject, however, he admitted to be one requiring more accurate and extensive investigations, and he hoped that the metamorphic strata of the eastern shores of the Atlantic may be studied, with a view of determining how far the principles laid down in this paper may be capable of general application.

Mr. Jukes remarked that Dr. Hunt's paper was one of the most important and comprehensive ones that he had ever heard laid before any society. He would only say that he congratulated himself and the Survey on this paper having been brought before the society, before the Geological Survey attacked the primary and the metamorphic rocks of Connaught and Ulster.

Professor Haughton said that as far as he had been able to catch one or two statements in the paper, it appeared that Dr. Hunt was inclined to return to the views of Werner on metamorphism, referring this action mainly to aqueous agency, to which action he would also refer the filling of lodes. He was, however, hardly inclined to agree with Mr. Hunt that the presence of sulphur and of phosphorus in a free state were due to aqueous agency and reduction by means of the decomposition of vegetable matter. As regards carbon, he was disposed to admit the conclusions of Dr. Hunt, as that element required the agency of organic life to separate it from its compounds with oxygen. Phosphorus did not occur in a free state in the earth, as it was very liable to oxidation, and therefore was found combined with oxygen.

WHITNEY'S REPORT ON THE UPPER MISSISSIPPI LEAD REGION.

Report of a Geological Survey of the Upper Mississippi Lead Region, by J. D. Whitney. Made by the authority of the Legislature of Wisconsin, under a contract with Professor James Hall, Principal of the Geological Commission of the State, in 1859-60. Albany, N. Y., 1862.

(*Continued from page* 153.)

After the general geological description, of which we have given an abstract, Prof. Whitney follows with a chapter on the Mineralogy of the

Region. The only mineral species found in economic or important quantities are—Galena, Blende, Smithsonite, and Pyrites, among the metallic ores, with Calcite and Chalcedony among the gangues. Copper pyrites, Anglesite, Azurite, and Zincbloom also occur, but only in small quantities. There is no Fluor, no crystallised Quartz, no Chalybite, and no anhydrous silicates.

The Galena of the Region, universally called "mineral" by the miners, presents a remarkable uniformity—being almost invariably crystallised, but the faces of the crystals being rough and corroded. The quantity of silver it contains is small.

The Blende found is almost always associated with the carbonate of zinc—indeed it is difficult to say which exists in the greater quantity. It is rarely found distinctly crystallised, but usually occurs in lamellar-radiated masses, with a concentric or rudely stalactitic structure. The Smithsonite (carbonate of zinc), the "dry bone" of the miners, seems to have been derived from the decomposition of the sulphide; for we find pseudomorphs of Smithsonite after blende, and also masses of carbonate, which, when broken open, show a nucleus of the sulphide remaining in the interior—while the converse never occurs. The "dry bone" occurs in every degree of purity, but the larger portion contains a considerable percentage of impurities.

Pyrites occurs in considerable abundance in connection with the lead deposits of the North-west. It is generally of the white, or spear pyrites, variety, and rapidly undergoes decomposition on exposure to the air, forming an earthy hydrous oxide, or "ochre," which frequently accompanies the lead ore in great quantities.

Calcite, both crystallised and stalactitic, is however the great lead gangue of the Upper Mississippi district, as it is of the great majority of the lead mining districts of the world. Its crystallisation, like that of the galena, is remarkably uniform, the ordinary calc-spar form and the dog-tooth form, largely preponderating. Large or well-formed crystals are rare.

The absence of crystalline quartz from the lead veins of this district is one of its most remarkable features. The lead-bearing strata, however, contain a great abundance of silicious matter in the form of Chalcedony, which forms numerous and heavy layers throughout the Galena limestone.

Some fair quantities of yellow copper ore have been met with at different points of the lead region, on which unsuccessful mining trials have been attempted. Anglesite (sulphate of lead) also occurs in small quantities lining cavities of galena. Azurite has been found at the old copper diggings near Mineral Point, and Zincbloom has likewise been met with coating Smithsonite.

From this Mineralogical chapter, the Professor passes to the consideration of the economical and mining geology of the district in Chapter VI, which he divides into five sections distributed as follows; which will best show his mode of treating the subject.

§1. General remarks on the occurrence of the metallic ores. Notice of the lead mining districts throughout the world. Statistics, general and comparative.

§2. Descriptions of the various forms of ore deposit peculiar to the lead region of the Upper Mississippi. Sheets; openings; flat sheets; flat openings. Arrangement of the ore in the openings. Section of the openings in the Blue limestone.

§3. Special description of the diggings in Wisconsin. Special remarks on copper mining in the lead region. On zinc mining and smelting.

§4. Theoretical considerations as to the mode of occurrence of the ore in the lead region: surface arrangement of the crevices—how formed—how filled with ore and other materials now found in them.

§5. Practical considerations:—Possibility of deep mining in the lead region. Mining in the Lower Magnesian. How the present system may be improved.

To give anything like a full abstract of this chapter, which extends over two hundred quarto pages, would far exceed the limits of our space. The first section, treating of lead mining generally, requires no special notice; but the second section, describing the various forms of ore deposit in the region, is one of great value, and full of new information of the highest interest—and on which consequently we shall dwell to some extent.

The simplest form of deposit seems to be the "sheet," by which is meant a solid mass of ore, filling a vertical or nearly vertical fissure. This the Professor takes to be the normal form of deposit, to be taken as a standard for all others; and he seems to consider it clear that in this case the galena remains as "originally deposited"—that "whatever changes in the chemical and mechanical character of the rocks and other ores associated with them may have taken place since the first filling of the crevices, there is no reason to suppose that the galena has itself been a sharer in these changes."

The dimensions of a "sheet" are very variable. In general its thickness does not exceed three inches—although there are rare cases in which it is larger—and it not unfrequently dwindles down to a mere film of ore no bigger than a knife-blade. Neither is the longitudinal extension great, but it varies from a few yards to one hundred: the greater the length and width, the more likely it is to lose its simple sheet character, and pass into some other form. Its vertical height, compared with the usual vertical development of ore deposits in the region, is sometimes considerable. From 20 to 40 feet are the most usual limits, but in some instances a much greater depth is attained. The deepest known workings on a continuous sheet are on the East Blackley range, where a continuous "sheet" of ore goes down for 140 feet.

The walls of the sheet have generally a distinct parallelism until they close up as the ore thins out and disappears. There are none of the accompaniments of a true vein—as gangue or veinstone; and if the ore fails while the crevice continues, the latter becomes filled with clay or ochre. Sometimes the ore is replaced by calc spar, particularly in the lower portions of the Galena limestone. These "sheets" are rarely of much extent in any direction; but a number of them are usually grouped together, and are thus profitably wrought in one working. Sometimes they occur exactly parallel within a narrow space, forming what is called a "sheet-lot," or a "gang of sheets."

A "sheet" seems to differ from a true vein, in being limited to a certain stratum or set of strata, beyond which it cannot be traced; in the absence of veinstone; and in the absence of smoothed or striated walls.

But although regarded as the normal form of deposit, the "sheets" really yield but a small portion of the ore raised in the region. In the greater number of instances the "sheet," or vertical crevice, is connected with what is called an "opening;" which is really a widening out of the crevice in some single stratum into a kind of cave, of very varying size, where the ore lies in fragments surrounded by, or embedded in, clay or decomposed rock, which, with ferruginous matter, generally fill it. This filling matter is called "dirt" by the miners, which, when it contains sufficient ore to pay, is called "pay dirt." Indeed, the essential difference between the "sheet" and the "opening" seems to be that in the case of the latter the rock has undergone decomposition, or become disaggregated, in the vicinity of the crevice, so that the ore lies disseminated through a mass of loose materials that can frequently be shovelled out. As stated, the width of "openings" is variable, but this name would not be given to anything not at least a foot wide. When small it is called a "crevice

opening," and when large a "cave opening;" and when the crevice opens and contracts suddenly, so as to give rise to numerous isolated cavities, the whole is called a "pocket opening." Openings are often lined with a stalactitic incrustation of carbonate of lime, and sometimes by a layer of galena.

Besides vertical there are also flat "sheets:" they differ chiefly as to position, but each kind is also characterised by essential peculiarities. The flat "sheets," instead of consisting of simple layers of galena, are frequently made up of blende, calamine, and pyrites associated with the galena; and there is also generally a veinstone, usually calc spar, called "tiff" by the miners. These matters are also not unfrequently arranged in a banded form on the walls of the opening, of which Prof. Whitney gives instances; but sometimes this only occurs on one side, and when this is the case it is worth observing that it is always on the upper side. Similarly to the vertical sheets the horizontal ones also expand into "flat openings," which are frequently also filled with "dirt," but which also sometimes contain the pure galena attached to the solid rock in groups or sheets of crystals. Mention is made of one cavity, three or four feet in diameter, studded with large crystals of galena firmly attached to the walls —one of which was 7″ in length across its face, and weighed between 60 and 70 lbs.

Besides the vertical and flat "sheets" and "openings," there is also the "double-flat or pitching" form, and the "saddle" form—which may be considered as passages between the vertical and flat types. In different parts of the lead Region also, the suddenness with which crevices or fissures expand and contract varies very widely; sometimes it is gradual, and at others sudden—the crevice opening out into a little cavern on a change of strata. Frequently also a wide "opening" is traversed continuously in length by a mass of undecomposed rock, called by the miners a "key-rock" —resembling which is called a "horse" in the Cornish nomenclature.

The vertical "openings" in the Galena limestone may occur at any stage of that rock; but in the Blue limestone the "flat openings" occur generally at certain beds, which are pointed out by Prof. Whitney. The number of openings which may occur over each other on a vertical crevice is varying: two or three are the usual number, but five have been observed. They are rarely equally productive, but the upper one is generally the most so, although cases do occur in which the lower ones are the richer.

The third section, which specially describes in detail the various mining works in the Region, is too full of detail to bear abstraction; but we may briefly refer to matters in the fourth section, devoted to theoretical considerations. The productive crevices seem to form in groups or districts, of which there are thirty principal ones enumerated. Whether the areas between these different groups of crevices are really unproductive seems to be a question under discussion; but Prof. Whitney believes they are, and that consequently a considerable portion of the region is destitute of valuable deposits of ore; and the reasons he gives for these views seem to us sound.

With regard to the bearing of these crevices, there seems everywhere to be a tendency to the formation of two sets, nearly at right-angles to each other. Of these but one set is, at any place, productive of ore, the other being made up of mere joints; and throughout a large portion of the Region those bearing nearest east and west are the most productive of lead. As to the nature of these crevices, Prof. Whitney does not regard them as true veins, but to have been originally closely allied to joints—formed in the same manner as similar planes of division occurring in almost every variety of rock. The facts brought forward to support this view are very full and interesting, and seem to demonstrate its truth.

The next point discussed is the mode in which these crevices became

filled with ore. As no lead has ever been found in the shales of the Hudson-river group, Prof. Whitney considers that it follows that the metalliferous matters did *not come from below*. This is what we should expect from our experience of European districts; but although it affords a satisfactory negative proof as to whence the lead did *not come*, it does not help us much in showing where it *did come* from; and although the matter is exhaustively examined in this Report, all the author can definitely arrive at is that it is "a matter settled beyond all possibility of doubt that the lead deposits of the North-west must have been introduced into the fissures from above, and by precipitation from a solution." When the Professor goes beyond this, and expounds his hypothesis as to how the oceanic waters of early geological periods were probably highly impregnated with metalliferous salts; how the rocks deposited from them may consequently have been similarly impregnated; and how the infiltration of water, saturated with sulphuretted hydrogen, through these rocks may have produced the deposition of the sulphides in the joints;—he soars into a region of theory, or rather speculation, where we cannot dare to follow him. Suffice it to say that although, in our opinion, he goes, in this matter, too far beyond the bounds where proof or disproof is possible, he still handles the subject with candour and judgment.

In a business point of view, the fifth and last section is the most important portion of the Report—for it deals with the practical considerations that are to be deduced from all that precedes it.

The most important of these, and the only one we need refer to here, is the consideration of the prospects of the Region for mining in depth. Prof. Whitney's views on this subject are very clear: "It will be evident," he says, "that we do not intend to come forward as the advocates of deep mining in the Lead Region, although most of those who have published on this subject have strongly insisted on an entire change in the system pursued; and maintained that all which was necessary to make persistent and paying mines on the lead crevices was the want of capital and energy among those who have hitherto worked in that district." To those who are acquainted with metallic mining districts in any part of the world there is nothing very singular in this cry; for everywhere the same florid and exaggerated notions are put forward by mine-projectors. In this case, however, these high-flown views seem to have to a great extent originated with certain "geologists;" who, as no mining capitalists can be found to undertake the adventure, have recommended that the Upper Sandstone (only 80 to 100 ft. thick*) should be sunk through at the expense of the State of Wisconsin, at the cost of about 50,000 dollars, to reach the Lower Magnesian Limestone. If the trial were at all a reasonable one, of course this expense would not be of much moment—although in that case it would probably have been effected by private enterprise before this;—but Prof. Whitney shows conclusively that the whole notion is erroneous, and that such a trial presents no reasonable chances of success. Where the Lower Magnesian comes to surface it has never been profitably mined for lead, and there is no sound reason for supposing that its being overlaid by other rocks would alter these conditions.

In conclusion we may quote Prof. Whitney's very sensible answer to the question—What conclusions can geology draw that can benefit the miner?—"No amount of science or practice will ever enable any one to say before-hand just where a productive crevice may be found: the causes of their formation and subsequent filling with ore are too complicated and uncertain to allow of the result being predicted. In all mining districts, the principal result of scientific observation is to limit the area over which

* Compare, *ante* p. 150, *Mining and Smelting Magazine*, March, 1863.

explorations or actual mining operations may be carried on with a chance of success, and to put a stop to wild schemes of speculation."

The Report is accompanied by two large maps and nine smaller plates of maps, sections, and drawings of the limestone outcrops. Of the large maps—one is a general geologically coloured map of the entire lead district shown within the dotted line on the sketch map, Fig. 15, p. 151 (March, 1863), on a scale of half an inch to one mile; while the other, called by Prof. Whitney the "crevice map," on the enlarged scale of two inches to one mile, only includes the rich district between Dubuque, Galena and Shullsburg. The principal crevices, or veins, are laid down on both maps, but of course more fully on the two inch one, where no attempt is made to show any other geological features.

Correspondence.

SIR,—A few months ago you published in your Magazine a letter of mine in which I differed from Mr. Fallize's statement that silver was only sparingly carried off by lead fumes. Since then I have assayed some deposits from flues of lead furnaces, the results of which are as follows:—

	Per cent. of Lead.	Silver per Ton of Lead.		
		Ozs.	dwts.	grs.
Deposits in Improving Furnace Flue ..	44·50	8	18	4
„ „ Reducing „ „ ..	45·00	2	14	6
„ „ Refining „ „ ..	56·50	24	6	8

The quantity of silver contained in the lead passed through the Improving furnace was very various, indeed as was also the quality of the lead. Lead from the deposits of an Improving furnace is more likely to contain a higher proportion of silver than from any other furnace, because many of the impurities (particularly antimony) contained in the lead carry off silver very freely; but, in the Refining furnace the lead is pretty pure, and the proportion of silver is not so great. The lead passed through the refinery would contain from 350 to 400 ounces of silver per ton.

In assaying lead fumes for silver, the lead should also be determined, and the proportion of silver in the lead calculated, as the *fume itself* might really contain but a small portion of silver.

JAMES NAPIER, Jun.

Rotherhithe, *April 21st*, 1863.

Notes and Memoranda.

THALLIUM.—It has been made the subject of question abroad, whether Mr. Crookes—whose memoir on this element we published in our last volume—was really the first to recognize its metallic nature; for a claim to this discovery has been made on behalf of M. Lamy, a Belgian chemist, and the son-in-law of the well-known chemical manufacturer Kuhlmann. M. Lamy exhibited to a society at Lisle, in Belgium, a specimen of this metal, in the form of a small fused ingot weighing from 70 to 80 grains, on the 16th May, 1862; but in answer to any claim founded on this fact, it may be sufficient to state that Mr. Crookes had exhibited the new element —marked as "metallic," though in the form of a precipitate—at the International Exhibition on the 1st of May, 1862. He certainly only produced 20 grains of the element, in the form of a powder (for which he gives a very sufficient reason), while M. Lamy—having at his command the great resources of his father-in-laws's works—was able to exhibit four times the quantity, in the form of a fused ingot. Contending claims as to scientific discoveries are so common, and are so frequently taken up in the spirit of national partisanship, that we scarcely suppose Mr. Crookes is much disturbed by the claims or insinuatious of M. Lamy's friends. The following are the leading characteristics of this metal according to the most recent investigations. It has a bright metallic lustre, which it speedily loses in the atmosphere from oxidation. In colour it closely resembles cadmium, and it produces a fleeting mark on paper similar in appearance to that of black lead. It is much softer than lead, and is, indeed, the softest heavy metallic body yet discovered. It may be easily cut with a knife, and even indented with the finger-nail. It melts at a somewhat lower temperature than lead. It is volatile at a bright red heat, and burns with an intensely brilliant green light. Its specific gravity is 11·9, or a little higher than that of lead. Its atomic weight is about 203, or nearly double that of lead. It is one of the most dia-magnetic bodies known. In electric conductivity it is a little inferior to lead. It readily oxidizes by exposure to the air, but not in water, deprived of air. It forms two, and perhaps three, basic oxides and an acid oxide. The protoxide is yellowish, easily fusible, volatile, soluble in water, and strongly alkaline to test-paper. Many of its salts are beautifully crystallized, especially the sesquichloride, sulphate, nitrate, and chlorate. Mr. Crookes maintains that thallium belongs to the lead and silver group of metals, whereas Lamy regards it as one of the alkaline metals. This metal appears to be very widely distributed over the world, though in relatively small proportion. It chiefly occurs in the common mineral, iron-pyrites, but in no ore has Mr. Crookes succeeded in finding more than ten ounces to the ton. It has been also met with in native sulphur, and in certain sulphuretted ores of mercury, zinc, cadmium, and bismuth. Many specimens of commercial copper contain it in very sensible quantity; and this is a point well deserving the attention of our great copper smelters, as thallium renders the copper brittle, and otherwise deteriorates its quality.

THE MOUNT CENIS TUNNEL.—The Italian Minister of Public Works, General Menabrea, has made a report to the Lower House of Parliament, on the progress of this great undertaking, the general description of which was given in the September number of our last volume, where it will be remembered we referred to the new boring machines employed. The tunnel was begun in 1857 with ordinary means; but the first experiments with boring machines were not made until 1861 at Bardonnêche, on the Italian side; and even then the regular work did not proceed uninterruptedly until 1862. The invention of the new machine was in its infancy; so that its

occasional failures, and even its gradual improvements caused considerable delays. In the years 1857–8–9 and 1860, 724 metres had been achieved by ordinary means. By the aid of the new machines 170 metres were added in 1861, and 380 in 1862, making a total to the 1st of January last of 1,274 metres. On the Savoy side, at Modane, from 1858 to January 1, only the ordinary means were employed, and the result was for the whole of that period only 925 metres. The new method was applied, on this side, on 25th of January last, and, as there the errors which retarded the work at Bardonnêche will be avoided, it is anticipated that the result on both sides for 1863 will not be less than 800 metres, at which rate the whole undertaking will be finished in twelve and a half years. In 1862, to pierce 380 metres on the side of Bardonnêche, the men were employed 582 times, each time seven hours and thirty-nine minutes for boring, and six hours and two minutes for charging, blasting, and clearing away the stuff. During this time 45,751 holes were bored, from 75 to 80 centimetres in depth; 72,538 borers were set to work; there were 54,875 blasts, 18,622 kilogrammes of gunpowder were fired, 76,000 metres of fuse were burnt, and 1,334,000 cubic metres of compressed air were consumed, equal to 8,004,000 cubic metres of atmospheric air. The workmen on the 1st of January, 1863, were 720 at Modane and 900 at Bardonnêche; altogether, 1,620.

THE HARTLEY RELIEF FUND.—The adjourned meeting of the General Committee of this Fund was held on March 25th at Newcastle. After a long discussion it was resolved that the surplus should be distributed among twelve colliery districts, 1,500*l.* to each. Also that 100*l.* be expended in erecting a monument over the graves of the men buried in Earsdon churchyard. Mr. Foster's motion for donations of 500 guineas to the sufferers from the Walker colliery explosion, and of 100 guineas to those from the Coxlodge explosion, was put and lost.

LEAD IN COPPER.—In the last number of the *Journal of the Chemical Society*, Mr. F. A. Abel, F.R.S., in reference to a former paper read by himself and Mr. Field on the analysis of commercial coppers, where it is stated that "lead is of very rare occurrence in *cake* copper, both unrefined and refined," explains that the term "cake-copper" was intended to be applied to bar and blister-copper, to "best-selected" and foreign refined copper; but was not intended to include the "tough-cake-copper" of commerce, of which lead is almost an invariable constituent.

MINERS' ASSOCIATION OF CORNWALL AND DEVON.—The quarterly meeting of this association was held at Camborne on the 16th, the president, J. F. Basset, Esq., in the chair. A short paper was read by Mr. Pearce, one of the teachers, "On the Granites of Metalliferous Districts," after which a long and desultory discussion took place on the education of miners. From this discussion it would appear that, with some persons at least connected with the Association, no definite notion of its objects has yet been arrived at. It seems to be found, from experience, that the miners are unable, in consequence of their defective general education, to appreciate the special instruction given by the teachers of the Association: and to meet this it was proposed that evening schools should be opened, in connection with the Association, where young miners could improve themselves in reading, writing, and arithmetic—the traditional three R's. The president, however, did not seem to see what the Association had to do with teaching the A B C of education, which may be acquired in schools already in existence. Indeed, it may fairly be doubted whether the Association has not, even at present, extended its operations beyond its means. With an income of 300*l.* a year it has undertaken the technical education of the mining population from Exeter to the Land's End—a programme sufficiently extensive, one would suppose, without undertaking extraneous objects; particularly when we remember that besides this wide educational scheme,

the Association also includes among its objects the duties of an Institute of Mining Engineers, for the elucidation and improvement of mining processes, by the reading and discussion of papers, and their subsequent publication in the transactions of the Association.

PLATINUM CRUCIBLES.—At the meeting of the *Niederrheinischen Gesellschaft für Natur- und Heilkunde* at Bonn in the beginning of April, M. von Dechen produced two fragments of crucibles in which platinum had been fused with coke by Dr. Carl Bischof. One of these was still impregnated with threads of the metal, evidencing its perfect fusion; while a thin leaf of platinum, hammered from a grain taken from the other crucible, was shown as a proof of the great ductibility secured. Considering the intense heat required to fuse the metal, this was a sufficient proof of the highly refractory nature of the materials from which these crucibles are made—which consisted of clay occurring in the coal-measures of Waldenburg in Silesia, discovered by Dr. Bischof in his numerous researches on fire-proof clays. Of course platinum is more readily fused in graphite than in clay crucibles; but then the carbon of the crucible combines with the metal, and forms a carburet of platinum (similar in composition to crude iron, which is a combination of pure iron and carbon), which is very brittle, and incapable of being worked or hammered.

Patents relating to Mining and Metallurgy.

[Pressure on our space obliges us to postpone the remainder of matter until our next Number.]

ABSTRACT OF SPECIFICATIONS.

MANUFACTURE OF ARTICLES OF STEEL.—Provisional protection has been granted to Messrs. T. Richardson and R. Allinson, of London (No. 2,366), for "improvements in the manufacture or treatment of articles of steel, and in the apparatus employed therein." To obviate the difficulty in maintaining the requisite temperature in heating, annealing, and hardening steel, and to prevent its oxidation by the atmosphere, retorts or closed heating apparatus are employed. The retorts have arrangements for closing the ends, and slides for dividing them into compartments, which slides can pass into or out of either the sides or upper part of the retort, the spaces through which the slides enter being protected from atmospheric influence by suitable masonry. To deprive whatever air may pass into the retort of its decarbonizing influence on the steel, charcoal, coke, or coal is employed in the retort, or carburetted hydrogen or coal gas is passed through it, or a lining of clay and coke, or plumbago, is used. The retorts are to be arranged so that the heat will be highest at one end and diminish to the other. The patent also relates to hardening articles of steel, after the heating process, by exposure, in an iron cistern, surrounded with cold water, to an atmosphere in motion previously brought to a low temperature; or to immersion in cold liquid, by machinery, immediately on leaving the heating apparatus.

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Mining, Quarrying, and Metallurgical Review.

WESTERN COUNTIES.

ONE of the most terrible mine accidents ever known in Cornwall occurred at Botallack mine, St. Just, on Saturday the 18th, by which nine persons

lost their lives. In the first number of our *Magazine* (see Vol. I, p. 43), we gave a section of this mine, and of the new diagonal shaft, since named Boscawen shaft, sunk on the Crown's lode for the purpose of working the deposits of ore lying to the seaward. The shaft, or rather inclined plane, is sunk on the lode at a uniform dip of 32½° from the horizon, but with a varying direction, resulting from its following the course of the lode. In consequence of the hardness of the enclosing greenstone rock this inclined plane is small, only allowing room for a single line of rails, which are carefully laid on transverse and longitudinal sleepers. The drawing is by waggons and chains; but the men are brought up in a special carriage called a "gig," made of iron, 6′ 10″ long, 2′ 5″ wide, and 1′ 8″ high, provided with four seats, each arranged to hold two men,—and also furnished with a safety-catch, partly self-acting and partly controlled by the men in the gig. The railway is completed to the 192 fathom level, but the shaft is sunk 17 fathoms deeper, and there is an opening of 2′ 9″ between the line of rails and the sollar at the 192. The men killed were being drawn from the 165 fathom level, and the gig had reached the 135 fathom level when the chain parted near the surface, and the gig fell away to the bottom of the shaft. It does not seem to have left the rails as far as they continued, that is to the 192, where, passing under the sollar, it plunged into the lower and unfinished portion of the shaft.—At the inquest, held on the 21st, the verdict was "accidental death," the catastrophe being attributed to the carelessness, or want of presence of mind, on the part of the men in the gig in not bringing the safety-catch into operation. It is doubtful, however, whether under any circumstances, men should be drawn up by chains, whatever precautions there may be adopted in the shape of safety-catches or breaks. The uncertainty of chains is proverbial; and in every other mine in Cornwall where men are raised by skips, a wire-rope with a double-linked connecting chain is adopted. The experience of every country in the matter of safety contrivances is, that while they usually answer perfectly on trial, they almost as usually fail when a breakage really occurs. In reference to this accident a letter has been written to the papers by Mr. W. P. Jervis, Mining Engineer, strongly animadverting on the arrangements.

At the meeting of *Tincroft* mine held in London on the 21st, the late "scrip" directors disqualified and resigned, and the entire future management of the mine was transferred to Cornwall, Capt. William Teague being appointed manager and purser. An elaborate set of rules was submitted to the meeting for adoption by Mr. Childs, the late solicitor to the defunct company; but the shareholders wisely declined adopting them, and simply resolved that the business of the mine be in future carried on in accordance with the customs of the stannaries.—Another difficulty has arisen as to the boundary between this mine and Cook's Kitchen, but it is really a matter to be settled between the lords, and one with which the mines should not be troubled.

In the Great Fortune district there promises to be considerable activity. In Bounder's shaft at *Sithney Carnmeal* there is a most promising lode, although as yet not of much value; and two new concerns—*New Wheal Fortune* and *East Wheal Fortune* are about being started. The former has a full plant of machinery on the mine, which is in fork and ready to go to work at once; and the other is a promising piece of ground which can be explored to 30 fathoms deep by an adit level.

At *Alfred Consols* meeting on the 21st, Mr. T. W. Robinson was appointed purser in the room of Mr. Henry Noell, deceased; and it was resolved that the eastern part of the mine (Old Alfred Consols) be suspended, and such materials as can be spared disposed of. The prospects here are not very encouraging, but there are still one or two points of some importance to

come off.—At *Prosper United* also there was a heavy debit balance, but the mine is much improved, and under the new management there now seems every chance of success. This mine, it must be remembered, is really an extremely shallow one, counting from surface, and it will certainly be curious if other bunches of ore are not met with.—At *Clifford Amalgamated* there is an improvement of some importance in the United Mines, where, at Buzza's shaft there are two ends turning out 12 and 15 tons each of good quality ore.—At *Nangiles* adjoining, the 86 has improved to 20*l.* per fathom.

At *Wheal Margery* there has been an improvement in the 110 west, where the lode is worth 40*l.* to 45*l.* per fathom.—At *East Providence* a discovery has been made at the 60, of a bunch of tin reported worth 30*l.* per fathom.—At *Wheal Prudence*, working under the limited liability system, the pumping engine was put to work on the 4th, and the water is expected to be forked in about two months.—At *East Treskerby*, a new mine which has been working without result for about three years, there has recently been an improvement.

In the Caradon district there is little new to report. The returns at *East Caradon* seem to be steadily falling off, the ores realising 400*l.* less this month than they did last month. At the last meeting (on the 8th April), the resolution passed at the former account limiting the days of inspection to once a month was rescinded, and the old system of weekly inspection-days again adopted.—As the restriction was absurdly illegal it was certainly as well that it should be rescinded.—The silver at *Ludcott* having come to an end, even the London share-jobbers seem to have recovered their senses, and consented to regard the mine as a lead speculation.—A new limited liability company is started for working the *Carloggas* tin mine, in St. Stephen's parish, not far from St. Austell. There is now quite a large group of limited liability mines in this district, almost entirely supported by "outside" capital.

WALES AND THE BORDERS.

South Wales.—The trade of this district has been in a fairly active state; the majority of the works have been pretty regularly employed, and there is every prospect that this will continue to be the case for the next few months. In the vicinity of Swansea preparations are being made with the view of extending several works and erecting new ones, which will be the means of materially increasing the local trade. The copper works of the neighbourhood have been in regular employ. A new company is about to erect large copper smelting works on the Cramlyn burrows, and two other works are in contemplation.

The Yniscedwin iron-works in the Swansea Valley have entirely stopped. It is said, however, that there is every probability of their being shortly recommenced under the management of a London company.

Messrs. Jacob and Lewis are said to be about to erect another blast-furnace at their chemical works.

The new Marshfield Iron Works near Llanelly are now finished and set to work. They are the property of Messrs. Nevill, Everett, and Co., and will give employment to a large number of men.

It is considered rather surprising that the emigration from the South Wales coal and iron districts is larger at present than has even been known to be the case before.

Messrs. Partridge and Jones have blown in at Varteg, and a large number of men are already employed. This neighbourhood is reviving in com-

mercial prosperity, as, in addition to the Varteg furnaces. Messrs. Bevan and Co., Northampton, are actively proceeding in the rebuilding of the Golynos furnaces, and in a few weeks one if not two of these will be in blast. It is said that Northamptonshire ore, from Messrs. Bevan and Co.'s mines in that county, will be exclusively used.

The coal trade has been in a very satisfactory state. Most of the collieries have been very busy, there having been a good demand for export. Increased activity has been evinced at Abercarne, the second shaft having reached the black vein, and additional hands have been employed. Quotations show no change. The tin trade has slightly improved.

There was a good deal of business done at the principal South Wales shipping ports during the month of March; in fact, notwithstanding that the trade with the United States of America is now completely destroyed, the returns of some of the ports bear favourable comparison with the corresponding period for the past two or three years, and the trade of the first quarter of this year has been in advance of that of previous years.

Cardiff, the leading shipping port, has done a very large export trade, particularly in coals; the quantity sent to foreign ports proving that the various collieries in the interior of the district have been working regularly and satisfactorily. During the month of March, three hundred and sixty-four ships cleared out for foreign ports, the aggregate quanties of coal, iron, &c., exported, being 122,517 tons coal, 12,688 tons iron, 1,917 tons of coke, and 1,806 tons of patent fuel. The exports of the three months of the present year, compared with those of the corresponding period of 1862 and 1861, are as follows:—

1861	Coal 247,007 tons	.. ..	Iron 34,638 tons.
1862	„ 315,614 „	.. ..	„ 25,078 „
1863	„ 341,143 „	.. ..	„ 34,885 „

Being a very large increase in the exports of coal over either 1862 or 1861, but a small decrease of iron as compared with the first quarter of 1862.

At Swansea, the number of vessels entering the port during March was four hundred and sixty-nine, with an aggregate registered tonnage of 53,794 tons; and the total shipping rates received were 1,348*l.* 10*s.* 0½*d.* Comparing the trade of the port for the first quarter of the current year with the corresponding period last year, we have the following results:—Total number of vessels entering the port for the past three months, 1,198, with an aggregate registered tonnage of 149,340 tons, and the shipping rates received were 3,864*l.* 17*s.* 7*d.*; the corresponding period of 1862—1,478 vessels, with a registered tonnage of 172,497 tons, and the shipping rates were 4,199*l.* 1*s.* 3*d.*

The returns from Newport, Llanelly, and Neath, have not been published.

The prospectus of the *Blaen-y-Cwm Coal Company* has been published. The capital is to be 7,500*l.* in 1,500 shares of 5*l.* each. The company is formed for the purpose of working the coal said to exist in large quantities on the Blaen-y-Cwm and Cefn-Mawr estates near Neath.

From the *London Gazette* of April 21st, we find that the partnership between H. Willyams, A. Druce, M. Treherne, G. T. Thomas, C. W. Nevill, C. F. Devas, W. H. Nevill, H. Druce, and E. W. B. Willyams, Llanelly, and Queen-street-place, city, copper smelters, has been dissolved as far as regards M. Treherne.

The annual court of proprietors of the *Governor and Company of Copper Miners in England* was held in London on April 2nd. It appears from the report read at the meeting, that the depression in the copper trade has been such as to cause a loss of 5,014*l.* during the year ending January last.

NORTH WALES.—The slate trade in this district is in a very flourishing condition. An unparalleled demand for slates exists at the present time, and so greatly does it exceed the supply that all the slate quarries which have been for years abandoned in the district of Harlech, and other parts of Merionethshire, which is distinguished for its mineral resources, are now being again worked with most hopeful expectations. Ample returns are expected, and a spirit of enterprise prevails. A large quarry has been just opened at Llanbedr, and preliminary preparations are now going on with a view to its being worked with great vigour.

The respectable mines in the Minera district are advancing steadily. At *Park Mine*, the Minera upper day-level has been cleared out and repaired, and commenced driving towards the Park vein. The amount driven since it has been cleared out has been 20 yards—but it is estimated that 25 yards per month will be averaged; so that, as the distance to be driven is 260 yards, the Park vein will be intersected in from ten to eleven months. The new shaft is also sinking at a satisfactory rate considering the hardness of the ground, and is now down 160 yards. At *South Minera* the shaft is 18 yards below the 108 yard level, and it is expected that the vein will be seen 25 yards below this level in eighteen months' time. The shaft on the Gommerian lode has also been holed through to the level.—It is scarcely necessary to say the mines of the London brokers in this district have gone the way that London brokers' mines generally do go. Being brought forward merely to sell—and that operation being performed—their occupation is naturally gone.

GLOUCESTERSHIRE.—Among the imports into Bristol during the month have been: 322 tons of pig-iron from Glasgow and Belfast; 997 tons of sulphur-ore from Arklow and Pomaron; 31 cases of copper ore from Rotterdam; and 11 casks of lead from Liverpool. Among the exports: 473 tons of coal, and 163 tons of iron.

MIDLAND COUNTIES.

STAFFORDSHIRE AND WARWICKSHIRE.—Trade in this district has been dull. At some of the works the puddlers have been out for some time, and orders have not been received to the extent that is usual after the quarterly meetings of the ironmasters. There has been a fair enquiry for boiler-plates of the best descriptions. Native ore and gubbin have been in good request, and increased prices have been demanded for ironstone.

The quarterly meetings of the ironmasters of the Midland Counties have been held during the month. At Wolverhampton on the 8th, at Birmingham on the 9th, and at Dudley on the 11th. At Wolverhampton, the attendance was only moderate, and there was not much disposition to do business. There was not much demand for pig-iron, and the masters who do not raise their own "mine" have been doing only badly, as they have to encounter the increasing competition of the Cleveland and Forest of Dean districts. The number of furnaces in blast was stated to be about the same as three months ago, and last quarter-day prices were asked for the best hot-blast iron.

At the Birmingham meeting the attendance was good, but still there was a disposition to hold back orders, so that the quantity of finished iron sold was less than it was three months ago, and common bars, as well as an inferior make of pig-iron, were sold at lower prices than at that period. The sales of pig were not on a large scale, and the prices for the best mine pig ranged from 3*l.* 2*s.* 6*d.* to 3*l.* 7*s.* 6*d.* per ton. Native ironstone was in good demand.

At Dudley the attendance was small, and only a very moderate amount of business was transacted. This consisted mainly of sales of pig iron at

prices, for good hot-blast, about on a par with those realized at the Birmingham meeting quoted above. In the inferior qualities of pig there has not been much doing.

The coal trade has, on the whole, been brisk. In the Kingswinford and Himley district new pits have been opened, where there is a good supply of maiden coal.

The *Turnhurst Hall Colliery and Ironstone Company* (limited), in 15,000 shares of 5*l.* each, has been formed for the purpose of purchasing and working the coal and ironstone in the Turnhurst Hall Estate, near Tunstall, North Staffordshire.

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—There is nothing new to notice in this district. The coal trade has been much depressed, and it is feared will continue so. The iron trade is in a healthy condition, though there is not much doing. The ship-building trade on the Tyne and the Wear has been most active.

The exports from the Tyne during the month include: 148,270 tons of coal; 10,047 tons of coke; and 36,230 cwts. of iron. Among the imports have been: cargoes of sulphur pyrites from Rotterdam, Dordt, Antwerp, Levanger, and Genoa; cargoes of iron pyrites from Pomaron, Seville, and Drontheim; cargoes of manganese ore from Antwerp, Rotterdam, and St. Lucar de Guadiana; 9,400 ingots of copper from Alten; 40 tons of lead from Seville; and 7,032 bars of lead, and 30 tons of copper ore from Carthagena.

SCOTLAND.

Coals have been in moderate demand for home use and for shipment. The quantity exported during the month from the principal Scotch ports was 85,767 tons, against 101,513 tons during the same period last year—showing a *decrease* of 15,746 tons.

The pig-iron market has been dull at declining prices. The following are the returns of the shipments of Scotch pig-iron during the first quarter of the present year, as compared with the corresponding periods of 1861 and 1862:—

Week ending	1863.	1862.	1861.
	Tons.	Tons.	Tons.
January 3	5,973	7,707	5,202
„ 10	6,520	8,882	7,280
„ 17	7,203	9,308	9,266
„ 24	6,162	8,915	9,771
„ 31	4,609	9,917	7,748
February 7	6,922	11,122	9,083
„ 14	10,584	7,961	8,291
„ 21	9,896	9,627	6,616
„ 28	11,465	10,904	9,080
March 7	11,796	9,042	7,117
„ 14	12,324	12,011	7,982
„ 21	16,394	12,158	8,206
„ 28	10,395	11,284	10,169
Totals	120,243	128,838	103,811

In the face of many discouraging circumstances, the Clyde ports—Glasgow, Greenock, and Port Glasgow—continue to make a steady onward

progress. The Customs' duties collected at Glasgow in the quarter ended March 31, 1863, amounted to 230,106*l.* against £11,467*l.* in the corresponding three months of 1862, and 223,766*l.* in the corresponding three months of 1861. At Greenock the Customs duties amounted to 304,443*l.* in the quarter ended March 31, 1863, against 243,041*l.* in the corresponding three months of 1862, and 193,217*l.* in the corresponding three months of 1861. At Port Glasgow the Customs realized 40,737*l.* in the quarter ended March 31, 1863, against 36,562*l.* in the corresponding three months of 1862, and 37,035*l.* in the corresponding three months of 1861. In the year ended March 31, 1863, the Customs' duties collected at Glasgow amounted to 974,400*l.*, at Greenock to 1,172,732*l.*, and at Port Glasgow to 129,739*l.* In the year ended March 31, 1862, the corresponding totals were 912,196*l.* at Glasgow, 957,524*l.* at Greenock, and 129,205*l.* at Port Glasgow. In the year ending March 31, 1861, the further corresponding totals were 906,895*l.* at Glasgow, 834,186*l.* at Greenock, and 88,019*l.* at Port Glasgow. The total Customs' revenue of the Clyde in the year ending March 31, 1863, was consequently 2,276,871*l.*, against 1,998,925*l.* in the twelve months ending March 31, 1862, and 1,829,100*l.* in the twelve months ended March 31, 1861. An advance of 447,791*l.*, or about 20 per cent., has thus been established in two years.

FOREIGN AND COLONIAL.

FRANCE.—In the Haute Marne district there has been considerable activity. At Paris, business in copper has been quiet, and transactions limited. Iron has been rather neglected; quotations from St. Dizier are: rolled pig, 9*l.* 7*s.* to 9*l.* 10*s.*; hammered, 10*l.* 15*s.* to 11*l.*

The iron-works of St. Louis, near Marseilles, are about to light a large furnace, similar to those at Ulverstone, which will produce from 50 to 60 tons per day. The St. Louis Works, which employ principally the ores of the Island of Elba, produce a steely pig, which is worked at Allevard and St. Etienne. It bears a close resemblance to that of Siegen, but while the German pig contains about 10 per cent. of manganese, that of St. Louis contains only from 5 to 6 per cent. of that element.

BELGIUM.—The coal trade has been scarcely so active as it usually is at this season of the year, and there are large stocks on hand. The success of the Belgian firms in obtaining the contracts for 10,000 tons of rails for the Netherlands railways has imparted considerable firmness to the Belgian iron trade. It is said that the Hourpes-sous-Thuin blast furnaces are about to be re-lighted. These works belong to the Sambre Blast-furnaces and Rolling-works Company, which, besides, possesses the rolling-works of Bois-du-Tilleul, at Maubeuge.

BOHEMIA.—A limited liability company has been formed, called the *Abertham Mining Company*, for the purpose of working the St. Mauritius tin mines, situated at Abertham, Bohemia. The proposed capital is 150,000*l.*, in 30,000 shares of 5*l.* each.

CANADA.—Large quantities of very pure petroleum oil are, it is said, being procured from a boring on the Thames river, 17 or 18 miles south of Enniskillen.

TASMANIA.—Two expeditions are out to the westward in search of mineral wealth, signs of which have long been believed to exist in that part of the island. One party is under the charge of Mr. Gould, the Government geologist; the other is less scientific, but (some think) likely to be more practical, consisting of men who have had a Victorian experience in quartz-crushing. Poor Tasmania seems to want wealth of some sort; though it is by no means certain that to find gold would be a real and lasting benefit. Probably a sounder hope may be built upon her coal-fields, which promise to be extensive and valuable.

Record of the Mining and Metal Markets.

METALLIC-ORE MARKETS.

TIN.—The tin standard has not altered since our last, and therefore remains at—

Superior Fine	.. £110	Superior Common	.. £106
Second Fine	.. 108	Second Common	.. 105

In the early part of the month an advance was daily expected, but has not yet been realized, although several mines have received from the smelters more than the quoted rates for their black tin.

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard have been as follows:—

Date.	*Tons.*	*Produce.*	*Fine Copper.* Tons. cwt.	*Price per ton.*	*Standard.*
Mar. 26.	.. 3,271	.. 6¼	.. 220 13	£5 1 0	£115 11 0
Apl. 2.	.. 3,251	.. 6¼	.. 217 9	5 1 0	116 19 0
„ 9.	.. 1,875	.. 6⅛	.. 123 2	4 19 6	116 15 0
„ 23.	.. 4,930	.. 5⅞	.. 288 10	4 5 0	119 12 0

At the sale of the 26th, the standard advanced a little more than 1*l.* At the sales of April 2nd and 9th it remained stationary. There was no sale on the 16th; and at the sale of the 23rd the standard declined 1*l.* 10*s.*

LEAD.—Comparing this month's sales with those of last month, we find that prices have, on the whole, slightly declined.

COAL MARKETS.

LONDON, *April 28th.*—From the returns of the Registrar of the London Coal Exchange, of the quantity of sea-borne Coal, Culm, and Cinders, imported into London in the month of February, we learn that the total quantity was 288,429 tons, against 270,424 tons during the corresponding month of last year, showing an *increase* of 18,005 tons.

The following are the particulars of the 288,429 tons imported during February:—

Newcastle ..	97,695 tons, in 256 ships	Scotland ..	1,463 tons, in 8 ships
Seaham ..	18,372 „ 72 „	Wales ..	16,737 „ 34 „
Sunderland .	80,953 „ 198 „	Yorkshire ..	3,278 „ 36 „
Middlesbro'.	6,281 „ 26 „	Small ..	1,653 „ 10 „
Hartlepool..	58,286 „ 202 „	Cinders ..	1,466 „ 12 „
Blyth ..	2,245 „ 8 „		

The quantity of coal imported by railways and canals during the month of February was 158,022 tons, against 125,486 tons during the corresponding month last year—showing an *increase* of 32,536 tons.

During the month, the London coal market has been quiet. On the 30th, the ships arrived were 64, and the market was dull: the prices were Hetton Wallsend, 16*s.* 6*d.*; Lambton Wallsend, 16*s.*; Stewart's Wallsend, 16*s.*; Braddyll's Wallsend, 15*s.*; Tees Wallsend, 15*s.* 9*d.*; Eden Main, 14*s.*; Heugh Hall Wallsend, 13*s.* 6*d.*; South Kelloe Wallsend, 13*s.* 9*d.*; Framwellgate Wallsend, 13*s.* 6*d.*; Hasting's Hartley, 14*s.*; Davison's West Hartley, 14*s.*; Bute's Tanfield, 12*s.* per ton. On April 1st, new ships 30, and market firmer. The 3rd being Good Friday no market. On the 6th, new ships 46, and prices rose. On the 8th, new ships 47, and an improved demand. On the 10th, new ships 52, market quiet. On the 13th, new ships 36, market quiet. On the 15th, new ships 18, with more enquiry.

On the 17th, new ships 11, market firm. On the 20th, new ships 104, market dull. On the 22nd, new ships 64, market firm. On the 24th, new ships 99, market heavy. On the 27th, new ships 65, market dull and prices rather lower: the closing prices were, South Hetton, 17*s.*; Eden Main, 14*s.*; Wharncliffe, 13*s.*; Heugh Hall, 14*s.*; Bellside Hartley, 15*s.* 6*d.*; Lambert's Hartley, 16*s.* 3*d.*; Bute's Tanfield, 12*s.* per ton.

LIVERPOOL.—From Messrs. J. and T. Platt's Coal Circular for April, we find that the quantity of coal, cannel, coke and patent fuel shipped from Liverpool to foreign and colonial ports during the month of March was 36,349 tons, against 49,687 tons during the corresponding month of last year—showing a *decrease* of 13,338 tons. The shipments coastwise during March were 7,186 tons against 3,688 tons during the same month last year—showing an increase of 3,498 tons.

BRISTOL.—The oversea exports of coal from Bristol during the month of March were 385 tons against 719 tons during the corresponding month last year—showing a decrease of 334 tons.

GENERAL EXPORTS.—By the Monthly Circular of Messrs. Laird, Liverpool, we learn that the quantities of coal exported during March was 655,438 tons, against 652,487 tons in the corresponding month of 1862, showing an *increase* of 2,951 tons. The particulars are—From the Northern ports, 353,420 tons; Yorkshire, 25,456 tons; Liverpool, 35,993 tons; Severn ports, 186,516 tons; and Scotch, 54,053 tons. The *increase* was—Yorkshire, 9,282 tons; Severn ports, 815 tons; Scotch ports, 15,816 tons. The *decrease*—Northern ports, 12,307 tons; Liverpool, 10,655 tons.—The total exports from January to March were 1,535,432 tons, against 1,696,524 tons in 1862, showing a *decrease* of 161,092 tons.

CONTRACTS.—The Talargoch Mining Company require tenders for a weekly supply of 130 tons of Coal; and the Admiralty require 2,500 tons of South Wales coal, for the steam shipping at Sierra Leone.

SHARE MARKETS.

LONDON, *April 28th.* The London share-market has been characterised during the past month by unusual dullness. The amount of *bonâ fide* business transacted has been small, and the market transactions, except in two or three mines, have been trifling compared with any month during the past half-year.

The largest amount of business has been in *East Caradon* shares. At the close of last month they recovered to some extent from their heavy fall, and on the 30th were quoted 41½*l.*-42¼*l.* on the report of a branch being cut in the 60 cross-cut. On the 1st they were largely dealt in, opening 42½*l.*-43*l.*, from which they advanced to 45*l.*, but again receded, and were quoted 40*l.*-41*l.* on the 2nd. They remained at about this quotation until the 9th, when they dropped to 40¾*l.* sellers; but on the 10th they again rallied to 41½*l.*-42½*l.*, at which price they remained steady to the 20th, when they bettered and were strong at 42⅝*l.*-43⅛*l.*, on the report of an improvement in the 60 east. On the 24th they were dull at 42*l.*-43*l.*, and have since continued flat, closing at 41¼*l.*-41½*l.*

Marke Valley shares have been rather better. They opened on the 31st at 7⅝*l.*-7⅞*l.*, and gradually improved until the 14th, when they were quoted as high as 8½*l.*-9*l.* But this price has not been maintained, for on the 24th they had receded to 7⅜*l.*-7⅝*l.* *West Caradon* shares have receded 5*l.*, from 32*l.*-33*l.* to 27*l.*-28*l.* *South Caradon* unaltered at 400*l.*-410*l.*

East Basset shares have fluctuated considerably, but have maintained a good advance on last month's closing prices. They opened as low as 79*l.*-81*l.*, but by the 13th had advanced as high as 89*l.*-90*l.* On the 14th they experienced a heavy fall, being quoted 82½*l.*-85*l.*; but they imme-

diately rallied, and steadily advanced to the 23rd, when they were as good as 94*l.*-96*l.* On the following day, however, they again fell heavily, being quoted as low as 86*l.*-88*l.*, but close a little firmer at 87*l.*-89*l.* *Copper Hill* shares have been weaker. They opened on the 30th at 84*l.*-86*l.*, and at one time had fallen as low as 77*l.*-79*l.*; but they have again rallied, and close at 81*l.*-83*l.* *North Basset* shares have advanced from 4¼*l.*-4½*l.* to 5*l.*-5¼*l.* *Wheal Buller*, 58*l.*-60*l.*

North Roskear, which this month has been quoted as separated from its western portion, which has been constituted a distinct adventure as Roskearnoweth, has been comparatively neglected, and has steadily declined now that it has ceased to be the "market" mine of the day. Shares opened on the 1st at 39*l.*-41*l.*, and have fallen continuously to 32*l.*-33*l.*, at which they close *Roskearnoweth* shares were in request in the beginning of the month, but have also receded since. They opened on the 1st at 11½*l.*-12½*l.*, and advanced by the 4th to 14½*l.*-15½*l.* Since then they have become dull, and close 11*l.*-12*l.* *North Crofty* shares have also declined to 4¾*l.*-5*l.* *South Crofty* shares have receded from 29*l.*-31*l.* to 27*l.*-29*l.*

Tincroft shares have been weaker this month. They opened 22*l.*-23*l.*, and close 21*l.*-21½*l.* *Cook's Kitchen* shares have been dull at 27*l.*-28*l.* *Stray Park* shares have been weaker, at 37*l.*-38*l.* *Wheal Harriett* has also been heavy. Shares opened on the 1st at 3*l.*-3⅛*l.*, and were dull through the month, having been as low as 2⅞*l.*-3*l.*, but close better at 3⅛*l.*-3¾*l.* *Wheal Grenville*, 5½*l.*-5¾*l.*

Great Fortune shares have also participated in the general dullness. They opened on the 30th at 37½*l.*-38½*l.*, and had receded, by the 13th, to 34½*l.*-35½*l.* They have, however, again rallied, and close 36½*l.*-37½*l.* *Wendron Consols* shares have similarly declined 3*l.* per share on our quotations of last month. They opened on the 30th, 15½*l.*-16½*l.*, and close 13½*l.*-14½*l.* *Sithney Carnmeal* shares sprang into demand about the 17th, in consequence of an improvement in Bounder's shaft, close to Great Fortune boundary. They were first quoted at 3¼*l.*-3½*l.*, but have advanced to 4½*l.*-4¾*l.* *Calvadnack* shares rather lower, having fallen from 9*l.*-9½*l.* to 8¼*l.*-9*l.*

Wheal Ludcott and Wrey shares have been receding, and at one time had fallen heavily. They opened on the 30th at 6⅝*l.*-6¾*l.*, and receded steadily to 4¾*l.*-5*l.* on the 24th, but again rallied and close, 5⅜*l.*-5½*l.* *Wheal Mary Ann*, 15½*l.*-16½*l.* *Cargoll*, 45*l.*-47*l.* *Herodsfoot*, 47½*l.*-48½*l.* *Wheal Trelawny*, 16½*l.*-17½*l.*

Wheal Seton shares have been very quiet with scarcely any alteration. They opened 250*l.*-252½*l.*, and close 240*l.*-245*l.* *West Seton*, 250*l.*-260*l.* *East Carn Brea* shares flat. They opened on the 1st at 9*l.*-9¼*l.*, and close 8¾*l.*-9*l.* *South Frances*, 85*l.*-90*l.* *South Tolgus* has declined from 57*l.*-59*l.* to 51*l.*-53*l.* *Clifford Amalgamated* are slightly better, having opened 20*l.*-21*l.* and closing 21*l.*-22*l.*

Pendeen Consols shares have been duller. They opened on the 30th at 7½*l.*-7¾*l.*; on the 2nd they advanced to 7¾*l.*-8*l.*, but have since been weaker, the last price being 7½*l.*-7¾*l.*

Providence shares remain unaltered at 42*l.*-44*l.* *Wheal Margaret* shares have considerably declined during the month. They opened on the 31st at 36*l.*-37*l.*, and have gradually receded, closing at 32*l.*-33*l.* *Wheal Kitty* (St. Agnes) shares have gone up. They opened on the 30th 4¾*l.*-5*l.*, and have advanced to 6*l.*-6½*l.*

Drakewalls shares have advanced. They opened on the 2nd at 1¾*l.*-2*l.*, at which price they remained until the 16th, when they rose to 2⅛*l.*-2⅜*l.*, but close lower at 2*l.*-2½*l.* *Wheal Crebor* shares have also advanced from the opening price 29*s.*-31*s.* to 36*s.*-37*s.*, at which they close. *Wheal Edward*, 3*l.*-3⅛*l.*

Transactions are also reported in the following mines:—North Treskerby,

3⅜*l.*-3⅝*l.* *North Downs*, 2¼*l.*-2¼*l.* *East Rosewarne*, 3⅝*l.*-3⅞*l.* *East Russell*, 3⅛*l.*-3⅛*l.* *North Dolcoath*, 1¾*l.*-2*l.* *Wheal Uny*, 6⅝*l.*-7⅛*l.* *East Grenville*, 2½*l.*-2⅝*l.* *Hingston Down*, 2½*l.*-3*l.* *North Buller*, 6*l.*-6¼*l.* *Kelly Bray*, 15*s.*-17*s.* 6*d.* *Glasgow Caradon*, 4*l.*-4¼*l.* *Gonamena*, 2*l.*-2½*l.* *Wheal Grylls*, 29*l.*-30*l.* *Bottle Hill*, 6*s.*-8*s.* *South Carn Brea*, 3⅞*l.*-4⅛*l.* *North Robert*, 17*s.* 6*d.*-19*s.* *South Herodsfoot*, 4½*l.*-5½*l.* *Lady Bertha*, 17*s.* 6*d.*-20*s.*

In Welsh mines *Longrake* has been quoted at 18½*l.*-19½*l.* *Merllyn*, 5*s.*-6*s.* *Bryn Gwiog*, 29½*l.*-30½*l.*

In colonial and foreign mines business has been done at the following prices:—*Cape Copper*, 3*l.*-3⅛*l.* *Don Pedro North Del Rey*, ⅞*l.*—1*l.* prem. *Dun Mountain*, ½*l.* *St. John Del Rey*, 54½*l.*-56*l.* *Fortuna*, 4⅞*l.*-5⅛*l.* *Santa Barbara*, ¾*l.* *Port Phillip*, 1½*l.* *United Mexican*, 6⅜*l.*-6⅝*l.* *Yudanamutana*, 3⅞*l.*-4*l.*

DUBLIN.—The Irish mine share market opened very dull, but recovered a little towards the end of the month. *Wicklow Copper* have slightly receded from last month's quotations. They opened 38*l.*-38½*l.*, and leave off 39*l.*-39½*l.* *Carysfort* remain unaltered at 21*s.* 6*d.* *Mining Company of Ireland* shares have advanced from 19*l.*-19⅜*l.* to 19⅞*l.*-20*l.* *General Mining Company for Ireland* shares have receded from 4⅞*l.*-5*l.* to 4½*l.*-4⅝*l.* *Connorre*, 18*s.*-18*s.* 6*d.*

CORNWALL.—Although there has been no very great amount of business doing, still, prices have been generally pretty steady. *South Crofty* shares opened 31*l.*-32*l.*, but at the end of the month, in consequence of about thirty shares having been thrown on the market by some of the large holders, they declined to 27*l.*-28*l.* *Clijah and Wentworth* shares have advanced from 6*l.*-6½*l.* to 7*l.*-7½*l.* *Condurrow* shares have had a large rise. They opened 95*l.*-100*l.*, and have steadily advanced all through the month, closing at 125*l.*-130*l.* *Emily Henrietta*, 10½*l.*-10½*l.* *New Seton*, 122½*l.* *Rosewall Hill and Ransom United*, 3*l.*-3¼*l.* *West Tolgus*, 63*l.*-65*l.*

METAL MARKETS.

LONDON, *April 27th.*—Dullness has been the prevailing feature of the metal market during the past month; but although not much business has been done prices have been fairly maintained.

IRON.—The iron trade has been quiet at almost unaltered quotations.

Scotch pig-iron opened firm at 51*s.* 6*d.* In the middle of the month it was quiet at 51*s.*, but closes at 50*s.* 4½*d.*

Welsh bars have been in very little demand, but the ironmasters have been disinclined to lower their prices, which have been from 5*l.* 7*s.* 6*d.* to 5*l.* 10*s.* in Wales, 6*l.* 5*s.* f. o. b. in London. Staffordshire descriptions, best quality, have been in good steady request at list prices: inferior make less saleable. Swedish bars have been very scarce, there having been but few arrivals. Fine sizes have been held for 13*l.* There has been more enquiry for Indian specifications.

STEEL.—There has been little doing in Swedish keg or fagot. Advices from India have been discouraging, and no higher price has been obtained in Bombay than the present quotations here.

COPPER.—English has been quiet but steady, and smelters have strictly adhered to fixed prices both for raw and manufactured.

In foreign little has been doing, but prices have been well maintained. Burra Burra, 94*l.* 10*s.* Kapunda, 96*l.* Spanish, 86*l.* to 87*l.* Chili, 82*l.*

YELLOW METAL.—This metal has been in improved request. Sheathing has been very firm at 8¼*d.*; braziery sheets, 7½*d.* to 7¾*d.*

TIN.—English has been firm and in good demand at fixed prices, indeed smelters have refused orders at official prices, and an advance is shortly expected. Foreign has been quiet, but prices have been steadily main-

tained. Banca 128*l.* 10*s.* Straits, 123*l.* The Dutch market has been firm at 77*fl.*

TIN PLATES.—Prices have been well maintained, although the demand has been inactive.

LEAD.—The market for this metal has been dull. Good soft English, 20*l.* 7*s.* 6*d.* to 20*l.* 10*s.* L. B. 20*l.* 15*s.* W. B. 23*l.*

SPELTER.—The market for this article has been very quiet. Some business has been done at 17*l.* 17*s.* 6*d.* to 18*l.* W. H. 18*l.* 10*s.*

GLASGOW, *April* 23*rd.* IRON.—The pig-iron market has been inanimate all through the month, and quotations have receded from 51*s.* 9*d.*, the opening price, to 50*s.* 6*d.* The demand both for shipment and home consumption has been good. The quantity exported during April was 60,446 tons, against 53,664 tons during the corresponding month of last year—showing an *increase* of 6,782 tons.

BERLIN, *April* 18*th.* IRON.—The market for this article has been quiet, with little doing. Iron in bars from 3⅝–4 Thlrs. Staffordshire descriptions 5 Thlrs.

TIN.—There has been little demand for this metal, and prices remain about the same. Banca 45 Thlrs. English, 40 Thlrs.

COPPER.—This article has been in fair request. Kapunda, 33½ Thlrs. Burra Burra, 33 Thlrs. Demidoff, 36 Thlrs.

STETTIN, *April* 17*th.* COPPER.—This metal has been quiet. English 33–34 Thlrs.

TIN.—The market for this metal has been firmer. Banca, 44–45 Thlrs.

HAMBURG, *April* 16*th.*—Very little business has been done in metals. Copper, lead, and tin have been in small demand; but owing to the trifling quantities now in stock prices have been maintained.

AMSTERDAM, *April* 18*th.* TIN.—There has not been much doing in this metal. Banca remains unaltered at 76½ *fl.*

COPPER.—This article remains at 51½ *fl.*

LEAD.—This metal has been quoted at 12 *fl.*

CALCUTTA, *March* 23*rd.*—LEAD, unaltered; sales about 2,000 piculs.

IRON has been in rather more demand, but no improvement in prices can be noticed. Sales of all descriptions about 4,000 piculs.

LEAD.—144 piculs at $3 70*c.*

Furnished by Von Dadelszen and North, 158, *Leadenhall Street, London, E.C.*

We have had an unusually quiet market this month in every description of metals.

WELSH BARS remain dull at 5*l.* 10*s.* at the works, and at 6*l.* 5*s.* f.o.b. here. Staffordshire in good demand, prices tending upwards. Scotch pig-iron closes at 50*s.* 6*d.* cash.

COPPER.—Business is restricted as well in English as foreign; prices are quite nominal. We quote Burra at 94*l.* 10*s.* Kapunda 95*l.* Spanish 86*l.*-87*l.* Chili 82*l.*

TIN.—The position of this article is scarcely as good as at the beginning of the month. The demand for English has abated and Straits is a little easier: we quote it nominally 123*l.* and Banca 128*l.* 10*s.* The Dutch market is firm at 76½ *fl.*

TIN PLATES.—We report a very good business; and makers are fairly supplied with orders, although few new contracts are now being given out.

LEAD is dull: good soft English 20*l.* 7*s.* 6*d.* @ 20*l.* 10*s.* L.B. 20*l.* 15*s.* W.B. 23*l.*

SPELTER.—Some business has been done here at 17*l.* 17*s.* 6*d.* and 18*l.* at which we close with sellers. For Hull parcels the same prices have been made according to brand. W.H. 18*l.* 10*s.*

PRICES CURRENT OF METALS.

From Messrs. JAMES and SHAKESPEARE'S, 10, Austin Friars, E.C. *28th April.*

								Per Ton.			
IRON	Bars	(Welch)	..	in Wales	..	£5	10	0	@	£5	12 6
	„	„	..	„ Liverpool		6	2	6	„	6	5 0
	„	„	..	„ London		6	10	0	„	6	12 6
	Nail Rods	„	..	„ Wales	.	6	2	6	„	6	5 0
	„	(Staffordshire)	„	Liverpool		6	12	6	„	7	0 0
	„	„	„	London		7	0	0	„	7	10 0
	Hoops	„	„	Liverpool		8	0	0	„	8	2 6
	„	„	„	London		8	7	6	„	8	10 0
	Sheets	„	„	Liverpool		8	12	6	„	9	5 0
	„	„	„	London		9	5	0	„	9	10 0
	Bars	„	„	Liverpool		6	15	0	„	7	0 0
	„	„	„	London		7	7	6	„	7	10 0
	Scotch Pig (No. 1. g.m.b.)			the Clyde			—		„	2	11 0
	Rails			in Wales		5	10	0	„	5	15 0
	Swedish—Hammered—large sizes						—		„	11	5 0
	„	„	Indian assortments			11	10	0	„	11	15 0
STEEL	Hammered—faggot						—		„	17	0 0
	„	in kegs (¼ and ⅜ in.)				15	10	0	„	16	0 0
COPPER	Burra and P.C.C.						—		„	94	10 0
Australian	Kapunda					95	10	0	„	98	0 0
	Wallaroo					94	10	0	„	95	0 0
American	Baltimore						—		„	96	0 0
	Lake Superior						—		„	96	0 0
	Spanish Cake					85	0	0	„	87	0 0
	Chili and other Slab (for 96 per cent. pure Copper)						—		„	81	0 0
English	Tough Cake and Ingot and Tile						—		„	89	0 0
	Best selected Ingot						—		„	92	0 0
	Sheets, Sheathing and Rod						—		„	96	0 0
	Flat Bottoms						—		„	101	0 0
								Per lb.			
YELLOW METAL	Sheets							7¾*d.*	@	8*d.*	
	Sheathing and Rod							8⅛*d.*	„	8¼*d.*	
								Per Cwt.			
TIN	Common Blocks and Ingots						—		@	119*s.*	
English	„ Bars (in barrels)						—		„	120*s.*	
	Refined						—		„	124*s.*	
Foreign	Straits, Fine						—		„	123*s.*	
	„ (with 3 months' prompt)					124*s.*			„	125*s.*	
	Banca						—		„	128*s.* 6*d.*	
								Per Box.			
TIN PLATES at Liverpool 6*d.* Less	Charcoal IC, best					28*s.* 6*d.*			@	29*s.*	
	„ IX „					34*s.* 6*d.*			„	35*s.*	
	Coke IC					22*s.* 6*d.*			„	24*s.* 6*d.*	
	„ IX					28*s.* 6*d.*			„	30*s.* 6*d.*	
								Per Ton.			
LEAD	Sheet						—		@	£21	0 0
English	Pig—W.B.						—		„	23	0 0
	„ Other good brands					20	10	0	„	20	15 0
	„ German and Spanish, soft						—		„	20	5 0
English	Red						—		„	21	15 0
	Shot						—		„	23	10 0
	Dry White						—		„	26	10 0
SPELTER	(Silesian) in Cakes						—		„	18	0 0
ZINC	(Sheet) No. 9 and upwards						—		„	23	5 0
								Per Bottle.			
QUICKSILVER (in bottles containing 75lbs. each)							—		@	7	0 0
								Per Ton.			
REGULUS OF ANTIMONY, French Star							—		@	40	0 0

Tabular Abstract of Mining Accounts for the Month.

Date of Account.	Name of Mine, and Number of Shares.	Balances. Debit. £ s. d.	Balances. Credit. £ s. d.	Calls. Per Share. £ s. d.	Calls. Total. £ s. d.	Dividends. Per Share. £ s. d.	Dividends. Total. £ s. d.
	CORNISH AND DEVON MINES.						
Mar. 21	Frank Mills (5,000)	—	447 16 1	—	—	—	—
,, 21	Wheal Vyvyan (1,024)	964 7 9	—	1 0 0	1,024 0 0	—	—
,, 23	Trevenen and Tremenheere (5,600)	255 9 4	—	—	—	—	—
,, 24	East Treskerby (1,024)	615 5 1	—	0 12 6	640 0 0	—	—
,, 24	Wheal Emma (4,000)	—	739 14 1	—	—	—	—
,, 24	Wheal Trerew (2,048)	59 11 0	—	0 2 6	256 0 0	—	—
,, 24	East Grylls (2,048)	—	576 0 0	—	—	—	—
,, 24	South Tolgus (512)	—	388 1 5	—	—	—	—
,, 25	Wheal Arthur (5,990)	219 0 0	—	0 2 6	748 15 0	—	—
,, 25	Wheal Agar (6,000)	849 19 8	—	0 7 0	2,100 0 0	—	—
,, 25	Bedford United (4,000)	—	902 4 0	—	—	—	—
,, 25	West Basset (6,000)	—	5,700 13 0	—	—	—	—
,, 25	Wheal Grylls (1,024)	—	1,146 0 0	—	—	1 0 0	1,024 0 0
,, 26	Nangiles (1,024)	945 8 6	—	1 0 0	1,024 0 0	—	—
,, 27	Devon Great Consol (1,024)	—	32,212 17 6	—	—	9 0 0	9,216 0 0
,, 27	East Providence (4,096)	—	—	0 2 0	409 12 0	—	—
,, 30	Gonamena (6,144)	—	250 16 8	0 2 6	768 0 0	—	—
,, 31	Wheal Polmear (1,024)	—	421 5 7	—	—	—	—
,, 31	South Caradon (512)	—	3,883 6 4	—	—	4 0 0	2,048 0 0
,, 31	Craddock Moor (1,055)	—	948 3 0	—	—	—	—
,, 31	Lelant Consols (963)	677 4 10	—	1 0 0	963 0 0	—	—
,, 31	Furze Hill Wood (6,000)	647 4 9	—	0 2 0	600 0 0	—	—
,, 31	Clijah and Wentworth (787)	128 17 6	—	0 5 0	196 15 0	—	—
April 2	New Prospidnick (6,000)	—	123 0 0	—	—	—	—
,, 2	North Robert (6,144)	—	55 0 1	0 5 0	1,536 0 0	—	—
,, 2	South Seton (400)	618 12 6	—	2 10 0	900 0 0	—	—
,, 2	Wheal Basset and Grylls (1,000)	—	1,532 9 6	—	—	1 0 0	1,000 0 0
,, 7	North Treskerby (5,936)	—	928 14 4	—	—	0 1 6	445 4 0
,, 8	Marke Valley (9,000)	—	2,012 13 4	—	—	0 2 0	900 0 0
,, 8	East Caradon (6,144)	—	5,679 14 7	—	—	0 17 6	5,376 0 0
,, 8	North Crofty (5,610)	—	—	0 2 0	561 0 0	—	—
,, 8	East Seton (5,610)	—	—	0 1 0	280 1 0	—	—
,, 8	Carn Camborne (6,000)	—	—	0 1 6	900 0 0	—	—
,, 8	West Rose Down (1,000)	—	—	0 15 0	750 0 0	—	—
,, 9	Wheal Ludcott and Wrey (4,800)	—	1,536 2 2	—	—	0 2 6	600 0 0
,, 10	West Trevelyan (5,481)	—	603 10 1	—	—	—	—
,, 9	New Wheal Seton (400)	241 0 7	—	1 15 0	700 0 0	—	—
,, 13	Dolcoath (358)	—	3,806 18 10	—	—	8 0 0	2,864 0 0
,, 13	Wheal Margery (968)	810 10 11	—	0 15 10	766 6 8	—	—
,, 13	Wheal Seton (396)	—	2,213 0 0	—	—	3 0 0	1,188 0 0
,, 13	Wheal Crelake (12,000)	6,289 19 4	—	0 10 0	6,000 0 0	—	—
,, 13	Rosewarne United (3,848)	315 10 9	—	—	—	—	—
,, 14	West Wheal Seton (400)	—	3,168 4 9	—	—	5 0 0	2,000 0 0
,, 14	Wheal Par (1,024)	223 13 9	—	0 5 0	256 0 0	—	—
,, 15	Wendron Consols (1,024)	532 3 4	—	—	—	—	—
,, 15	East Margaret (1,024)	862 0 0	—	0 15 0	768 0 0	—	—
,, 16	Wheal Pollard (6,000)	707 16 1	—	0 3 0	900 0 0	—	—
,, 16	Wheal Jane (512)	294 0 0	—	—	—	—	—
,, 16	Prosper United (6,000)	2,705 18 3	—	0 10 0	3,000 0 0	—	—
,, 18	Wheal Rose (2,000)	593 8 3	—	0 12 6	1,250 0 0	—	—
,, 20	South Crofty (937)	669 0 1	—	1 0 0	937 0 0	—	—
,, 21	Alfred Consols (4,562)	3,079 10 9	—	0 13 6	3,079 7 0	—	—
,, 21	East Carn Brea (6,000)	—	1,066 15 2	—	—	—	—
,, 21	Wheal Kitty (St. Agnes) (4,295)	677 0 0	—	0 5 0	1,073 15 0	—	—
,, 21	E. Gunnis Lake and S. Bedford (4,000)	—	84 7 7	0 2 6	500 0 0	—	—
,, 21	Wheal Union (6,000)	321 2 6	—	0 3 0	900 0 0	—	—
	WELSH MINES.						
Mar. 31	Mwyndy Iron Ore (40,000)	—	4,483 0 0	—	—	0 2 0	4,000 0 0
April 4	Cwm Erfin (867)	—	—	—	—	0 10 0	433 10 0
,, 7	Garreg (1,000)	67 14 6	—	0 2 0	100 0 0	—	—
,, 7	Michell (3,475)	—	2 10 4	0 2 0	347 10 0	—	—
,, 7	Merllyn (4,480)	3 9 0	—	0 0 6	112 0 0	—	—
,, 10	South Minera (4,000)	—	595 18 2	—	—	—	—
,, 10	Park (5,120)	—	134 8 4	—	—	—	—
	FOREIGN MINES.						
Mar. 2	Linares (15,000)	—	6,820 0 0	—	—	—	—
,, 26	Fortuna (25,000)	—	5,985 0 0	—	—	—	—

Copper Ores.

Sampled March 11, and sold at the Tabb's Hotel, Redruth, March 26.

Mines.	Tons.	Purchasers.	Price.
South Caradon	102	8	£5 1 6
	92	8	7 9 6
	73	5, 7	4 16 6
	62	5	5 18 0
	58	1, 6	16 15 6
	50	12	1 9 0
	49	8	16 0 0
	32	1	5 10 6
West Caradon	79	7	6 15 6
	74	1	8 6 0
	73	5	4 16 6
	53	5	6 18 6
	49	14	4 15 0
	46	14	10 0 0
	43	7	5 16 6
	38	14	4 0 6
Great Wheal Busy ...	82	2	2 14 6
	78	9	1 19 0
	49	11	3 1 0
	48	7, 12	2 15 6
	44	9	2 10 0
	43	1	1 5 6
	32	6	6 2 0
	24	2, 9	3 1 0
	20	1	1 15 6
North Treskerby	65	14	5 1 6
	62	7, 9	3 14 0
	61	14	3 6 6
	58	14	4 19 6
	47	7	4 5 0
	46	3	4 15 0
	42	11	5 10 0
Clifford Amalgamated	104	7, 9	3 17 0
Clifford Amalgamated	64	3	£4 1 6
	52	5, 10	1 4 6
	44	5	3 10 0
	35	3	4 14 6
	24	10, 12	2 18 6
	15	1	0 14 0
Fowey Consols	82	1	5 11 6
	79	6	5 8 6
	77	6	5 8 0
	72	5	4 14 6
Wheal Polmear	96	14	4 16 6
	45	1, 12, 13	4 11 6
	41	14	5 2 6
	30	5	7 13 0
North Downs	61	3	6 3 6
	60	3	8 9 6
	55	3	5 8 6
	26	3	6 4 6
Craddock Moor.....	86	9	5 9 0
	46	9	5 0 6
	26	5	0 19 6
St. Day United	41	7, 10	3 10 6
	32	10	0 16 0
Wheal Rose	50	5	3 12 0
Burra Burra	41	10	3 6 0
Wheal Towan	26	12	2 0 6
Perran Mines	25	1	4 6 6
Wheal Prudence	22	5	2 17 6
Wheal Damsel	17	5, 12	2 15 6
	3	1	5 18 6
Buckingham's Ore ...	18	12	2 17 6
Pembroke	2	12	2 14 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
South Caradon	518	£3,929 12 6
West Caradon.....	455	2,964 17 0
Great Wheal Busy.....	420	1,126 18 6
North Treskerby	381	1,702 5 6
Clifford Amalgamated ...	338	1,124 19 6
Fowey Consols	310	1,641 14 6
Wheal Polmear	212	1,106 6 0
North Downs	202	1,345 8 0
Craddock Moor	158	725 4 0
St. Day United	73	£170 2 6
Wheal Rose.....	50	180 0 0
Burra Burra	41	135 6 0
Wheal Towan	26	52 13 0
Perran Mines	25	108 2 6
Wheal Prudence	22	63 5 0
West Damsel	20	64 19 0
Buckingham's Ore	18	51 15 0
Pembroke	2	5 9 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	297	£1,801 8 0
2 Freeman and Co.	94	260 1 0
3 Grenfell and Sons	347	1,990 1 6
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co. ...	544	2,537 9 6
6 Williams, Foster & Co.	217	1,526 1 0
7 Mason and Elkington ...	333	1,617 13 6
8 Bankart and Sons	243	1,989 7 0
9 Copper Miners' Co.....	349	£1,313 9 0
10 Charles Lambert	131¼	300 2 3
11 Newton, Keates & Co...	91	380 9 0
12 Sweetland, Tuttle & Co.	155¼	376 5 3
13 Neath Copper Co.	15	68 12 6
14 Penclawdd Co.	454	2,337 17 6
Total	3271	£16,498 17 0

Average Produce, 6¾.
Quantity of Fine Copper, 220 tons 13 cwts.

Average Standard £115 11
Average Price per ton 5 1 0

Copper Ores.

Sampled March 25, and sold at Tabb's Hotel, Redruth, April 9.

Mines.	Tons.	Purchasers.	Price.
West Basset	71	2, 10	£3 6 0
	64	6	5 2 6
	54	5	3 14 0
	53	1	3 10 0
	52	9	6 4 0
	49	5	5 19 0
	35	14	5 14 6
	32	5	5 13 0
Carn Brea	63	10	2 14 6
	55	7	7 14 0
	52	7, 11	3 14 6
	48	6, 10	2 14 6
	37	10	3 2 6
Par Consols	72	14	6 0 6
	60	3	7 3 6
	57	3, 9	3 12 6
	55	14	5 18 6
Great South Tolgus	65	7	8 16 6
	52	7	9 16 0
	46	11	3 15 6
Prosper United	71	5	3 0 0
	52	5	4 16 0
	23	5	1 8 6

Mines.	Tons.	Purchasers.	Price.
East Carn Brea	71	6	£4 19 6
	49	3, 14	8 12 6
Treloweth	64	2, 6	3 15 6
	20	2, 8	4 7 0
	17	1	10 9 6
	16	5	0 4 0
Copper Hill	64	5, 9	1 13 6
	48	1, 3	9 7 6
Pendeen Consols	57	7	2 9 6
	27	7	2 11 6
	21	13	3 6 6
Wheal Buller	58	2, 6	3 16 0
	10	1	11 2 6
Rosewarne Consols	35	3	7 1 6
	15	3	5 4 6
	10	3	5 13 0
Great Wheal Alfred	27	9	1 15 0
Rosewarne United	13	11	2 8 0
St. Austell Consols	11	12	3 17 0
Camborne Consols	11	11	8 10 6
West Tolvadden	9	5	2 10 0
Great Crinnis	4	12	1 15 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
West Basset	410	£1,944 1 0
Carn Brea	255	1,035 6 0
Par Consols	244	1,396 16 0
Great South Tolgus	163	1,256 17 6
Wheal Prosper United	146	495 7 6
East Carn Brea	120	775 17 0
Treloweth	117	509 17 6
Copper Hill	112	557 4 0
Pendeen Consols	105	280 8 6

	Tons.	Amount.
Wheal Buller	68	£331 13 0
Rosewarne Consols	60	382 10 0
Great Wheal Alfred	27	47 5 0
Rosewarne United	13	31 4 0
St. Austell Consols	11	42 7 0
Camborne Consols	11	93 15 6
West Tolvadden	9	22 10 0
Great Crinnis	4	7 2 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	104	£701 3 0
2 Freeman and Co.	106½	391 13 0
3 Grenfell and Sons	197	1,352 12 6
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	338	1,246 16 6
6 Williams, Foster & Co.	220	977 12 6
7 Mason and Elkington	282	1,814 3 6
8 Bankart and Sons	10	43 10 0

	Tons.	Amount.
9 Copper Miners' Co.	139½	526 11 3
10 Charles Lambert	159½	469 17 0
11 Newton, Keates & Co.	96	395 9 6
12 Sweetland, Tuttle & Co.	15	49 9 0
13 Neath Copper Co.	21	69 16 0
14 Penclawdd Co.	186½	1,171 7 3
Total	1875	£9,210 1 6

Average Produce, 6⅝.
Quantity of Fine Copper, 123 tons 2 cwts.

Average Standard £116 15 0
Average Price per ton 4 19 6

No Sale on April 16th.

Copper Ores.

Sampled March 18, and sold at Tyack's Hotel, Camborne, April 2.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	101	6	£6 18 0
	97	6	7 10 6
	89	5	6 2 6
	82	7	3 7 0
	74	8	3 19 6
	73	2, 8	3 4 0
	72	8	5 16 6
	71	3	4 11 6
	70	8	5 4 6
	35	6	4 3 6
	30	9	7 13 0
	29	12	4 8 0
(Consols)	84	1, 2	6 0 6
West Seton	104	10	2 13 6
	94	3	6 16 0
	74	14	4 17 6
	72	7	4 14 0
	71	14	6 6 0
	63	6	4 6 6
	44	9	6 1 6
	43	14	6 6 6
Wheal Seton	37	5, 6	4 4 6
(Pendarves)	82	13	5 5 0
	78	10	0 18 6
	71	9	4 19 6
	57	3	7 1 6
	41	3	12 17 0
East Pool	87	2	4 6 6
	72	7, 12	4 7 6
	55	1	0 6 6
East Pool	38	12	£3 15 6
	35	14	2 18 6
South Frances	66	1, 5, 9	5 10 0
	42	9	6 0 9
	42	8, 13	5 8 6
	32	1	6 1 6
	5	12	3 17 6
Wheal Basset	65	1, 13	6 11 6
	58	14	4 5 6
	37	1, 7	8 11 6
South Tolgus	81	7	4 1 0
	79	6, 13	5 19 0
East Basset	55	1	4 19 6
	43	5	6 14 0
	16	1, 5	18 6 6
Tincroft	65	7	4 17 0
	40	10	1 19 6
Condurrow	46	9	1 10 0
	43	7	3 11 6
Dolcoath	42	6, 13	5 18 6
	33	10	3 10 6
Stray Park	42	10	2 10 6
	20	7	7 2 0
North Roskear	45	3	8 15 0
Carn Camborne	34	12	2 6 6
	7	12	6 2 6
South Crofty	23	10	1 4 6
	17	13	6 13 6
Camborne Vean	36	1	4 10 6
New Wheal Seton	5	7	6 1 9

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amalgamated	907	£4,893 14 0
West Seton	565	2,873 0 0
Wheal Seton	366	1,942 6 6
East Pool	287	945 19 6
South Frances	194	1,099 17 0
Wheal Basset	160	992 12 0
South Tolgus	160	798 2 0
East Basset	114	854 18 6
Tincroft	105	394 5 0
Condurrow	89	£222 14 6
Dolcoath	75	365 3 6
Stray Park	62	248 1 0
North Roskear	45	393 15 0
Carn Camborne	41	121 18 6
South Crofty	40	141 13 0
Camborne Vean	36	162 18 0
New Wheal Seton	5	30 7 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	301	£1,541 15 6
2 Freeman and Co.	165	746 2 6
3 Grenfell and Sons	308	2,287 18 0
4 Crown Copper Co.	—	—
5 Sims, Willyams, & Co.	180	1,178 19 9
6 Williams, Foster & Co.	375	2,283 0 9
7 Mason and Elkington	422	1,898 12 9
8 Bankart and Sons	273	1,310 0 6
9 Copper Miners' Co.	262	£1,335 5 0
10 Charles Lambert	320	677 6 0
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	149	569 17 0
13 Neath Copper Co.	213	1,231 0 9
14 Penclawdd Co.	281	1,430 7 0
Total	3251	£16,490 5 6

Average Produce, 6¼.
Quantity of Fine Copper, 217 tons 9 cwts.

Average Standard £116 19 0
Average Price per ton 5 1 0

Copper Ores.

Sampled April 8, and sold at the Royal Hotel, Truro, April 23.

Mines.	Tons.	Purchasers.	Price.
Devon Great Consols...	134	9	£4 5 0
	133	6	5 1 6
	130	12	4 14 0
	126	14	4 3 0
	124	3	5 2 0
	121	2	4 7 6
	119	2, 13	4 18 6
	117	3	5 0 0
	116	3	4 15 0
	111	11	5 1 0
	101	6	4 16 6
	98	9	3 15 0
	97	1	8 0 6
	94	6, 13	4 13 6
	90	1	9 11 6
	89	9	5 0 6
	83	1, 10	3 6 6
	65	10	1 18 6
	60	7	4 8 0
	56	7	3 14 6
East Caradon	92	6	4 5 6
	86	5	3 18 0
	84	6	4 5 0
	70	1	4 2 6
	65	10	3 16 6
	55	5	8 8 0
	51	5	6 14 6
Phœnix Mines	105	10	3 0 0
	90	2, 6, 7	2 14 0
	89	5	3 1 0
	86	10, 14	2 3 0
	80	1	6 18 6
	20	1	1 2 6
Marke Valley	91	9	3 3 6
	86	3	3 7 6

Mines.	Tons.	Purchasers.	Price.
Marke Valley	85	3	£3 7 0
	81	3	3 7 0
	57	10	2 7 0
Devon and Cornwall...	91	5, 9	1 14 6
	67	10	1 17 0
	63	10	1 4 0
	40	5	9 7 6
	19	5	5 1 0
Bedford United	104	13	4 19 6
	96	5	4 5 0
Lady Bertha	57	12	1 11 6
	53	7	3 2 0
	52	5, 9	2 9 6
Crelake.....	65	6	4 19 6
	39	1	2 1 6
	30	6	3 5 6
Wheal Emma	45	1, 5	1 12 6
	42	1, 5	2 5 6
	37	5	4 5 0
Wheal Friendship	63	9	7 1 0
	42	1, 5	9 16 0
Brookwood	60	6	3 9 6
	22	9	6 7 0
	18	1	6 17 6
North Robert	53	7	0 13 0
	42	7, 11	5 12 0
South Bedford.....	41	10	0 7 0
	40	13	3 6 6
Gunnis Lake (Clitters)	61	5	4 19 0
Sortridge Consols	34	5, 7	5 5 6
	20	5	4 19 0
Wheal Arthur.....	34	7	2 3 6
	10	2	5 1 0
Hawkmoor	33	2	3 3 6
Fursdon	20	12	3 7 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols...	2,064	£10,078 3 0
East Caradon	503	2,428 1 0
Phœnix Mines.....	470	1,590 17 0
Marke Valley	400	1,269 4 6
Devon and Cornwall...	280	827 9 6
Bedford United	200	925 8 0
Lady Bertha	162	382 15 6
Crelake.....	134	502 11 0
Wheal Emma	124	325 18 6
Wheal Friendship	105	£855 15 0
Brookwood	100	471 19 0
North Robert	95	269 13 0
South Bedford.....	81	147 7 0
Gunnis Lake (Clitter's).....	61	301 19 0
Sortridge Consols	54	278 7 0
Wheal Arthur.....	44	124 9 0
Hawkmoor	33	104 15 6
Fursdon	20	67 0 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	520	£3,138 4 6
2 Freeman and Co.	253½	1,058 13 9
3 Grenfell and Sons	609	2,614 15 0
4 Crown Copper Co.....	—	—
5 Sims, Willyams & Co. ...	707	3,371 12 6
6 Williams, Foster, & Co....	642	2,843 9 0
7 Mason and Elkington ...	324	1,033 11 6
8 Bankart and Sons	—	—
9 Copper Miners' Co.	568½	£2,399 16 9
10 Charles Lambert	547½	1,267 0 9
11 Newton, Keates & Co. ..	132	687 3 0
12 Sweetland, Tuttle & Co.	207	767 15 6
13 Neath Copper Co.	250½	1,163 3 3
14 Penclawdd Co.....	169	615 7 0
Total.....	4930	£20,951 12 0

Average Produce, 5¼.
Quantity of Fine Copper, 288 tons 10 cwts.

Average standard £119 12 0
Average Price per ton 4 5 0

Copper Ores.

Sampled March 25, and sold at Swansea, April 4.

Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	99	13¼	7	£10 10 6
	96	13¼	5	10 10 6
	54	24	3	18 18 0
	52	23½	3	18 18 0
	10	33½	10	26 11 0
	107	13¾	3	10 14 0
	106	13½	7, 15	10 12 6
	115	13½	7	10 13 0
Cuba	100	10¼	6	8 2 0
	95	10¾	7, 15	8 3 0
	90	10¾	6	8 2 0
	81	19¼	2	15 9 6
	31	15¼	2	12 14 0
	12	68¼	10	51 3 6
	7	79	10	60 7 6
Knockmahon	70	10½	1, 6, 13	8 15 0
	64	11¼	1, 6, 13	8 15 0
	90	10	5	7 9 0
	88	11½	2	7 15 0
	69	10½	6	8 6 0
	53	9	7	9 10 6

Mines.	Tons.	Produce.	Purchasers.	Price.
Berehaven	80	10¾	13	£8 16 0
	69	10¾	1, 13	8 14 0
	111	10¼	1	8 4 6
	104	9¾	1	7 14 6
	80	10¼	1	8 4 6
Laxey	118	6¾	2	5 0 6
	23	5½	2	4 0 6
	102	6¼	3	4 15 6
	83	2¾	7	2 14 0
Lisbon	113	23¾	7, 15	19 5 0
New Cornwall	52	21¼	16	18 0 6
Kanmantoo	23	52	5	40 18 0
African	21	14¼	10	11 15 6
British Regulus	15	34	5	27 2 0
Calder Glen	7	5¾	16	4 8 0
Copper Ores	5	9½	5	7 8 0
Glo'ster Slag	3	32½	10	25 2 6
Phœnix	2	6¾	5	4 15 0
New South Wales	1	13¾	10	10 15 6
London Slag	10	7	5	4 10 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Cobre	639	£7,817 8 6
Cuba	416	4,997 3 0
Knockmahon	434	3,602 10 6
Berehaven	444	3,678 13 6
Laxey	326	1,396 13 6
Lisbon	113	2,175 5 0
New Cornwall	42	757 1 0
Kanmantoo	23	940 14 0
African	21	£247 5 6
British Regulus	15	406 10 0
Calder Glen	7	30 16 0
Copper Ores	5	37 0 0
Glo'ster Slag	3	75 7 6
Phœnix	2	9 10 0
New South Wales	1	10 15 6
London Slag	10	45 0 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Copper Miners' Co.	374⅛	£3,065 7 2
2 Freeman and Co.	341	3,014 14 0
3 Grenfell and Sons	315	3,635 7 0
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	236	3,082 12 0
9 Vivian and Sons	308⅛	2,539 10 8
7 Williams, Foster & Co.	507	5,033 10 6
8 British and For. Copper Co.	—	—
9 Mason and Elkington	—	—
10 Bankart and Sons	54	£1,635 18 0
11 Charles Lambert	—	—
12 Ravenhead Copper Co.	—	—
13 Sweetland, Tuttle & Co.	159⅛	1,394 19 8
14 Jennings & Co.	—	—
15 Neath Copper Co.	157	2,037 17 6
16 Penclawdd Copper Co.	49	787 17 0
Total	2,501	£26,227 13 6

Black Tin Sales.

Date	Mines.	Tons.	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Mar 20.	West Fowey Consols...	6	11	2	26	... 67	5	0	... —	} 504	11	0
	,, ...	1	4	2	16	... 50	0	0	... —			
	Par Consols.....	9	8	0	23	... 67	15	0	... —	... 637	11	0
,, 26.	West Fowey Consols...	24	17	1	13	... 67	5	0	... —	...1672	7	8
	Par Consols.....	17	0	3	21	... 67	15	4	... —	...1154	18	3
	Leeds and St. Aubyn...	1	8	2	20	... 68	0	0	... Chyandour Co.	} 121	10	6
	,, ...	0	7	3	26	... 60	5	0	... ditto			
,, 28.	Great Work.....	11	5	0	17	... 74	10	0	... —	... 838	13	8
	Drake Walls	18	0	0	0	... 70	0	0	... —	...1260	0	0
,, 31.	Great Wheal Busy.....	19	17	3	27	...	—		... —	...1194	0	10
	Pedn-an-drea	9	1	3	22	...	—		... Carvedras	588	18	8
April 2.	Cornubia	2	4	2	1	... 69	10	0	... New Blowing.....	} 337	17	8
	,, ...	0	3	3	9	... 64	5	0	... ditto			
	,, ...	2	5	1	13	... 69	10	0	... {High Blowing and			
	,, ...	0	4	1	13	... 61	10	0	... Daubuz & Co.			
	Prosper United	8	12	0	0	... 67	0	0	... Bolitho and Sons	576	5	0
,, 4.	Phœnix	9	2	3	0	... 64	0	0	... Bissoe Co.	584	16	0
	North Jane	3	6	0	9	...	—		... —	... 208	3	0
,, 6.	South Carn Brea.....	5	18	0	3	... 61	10	0	... Trethellan	} 724	14	8
	,, ...	5	17	2	18	... 61	10	0	... Redruth Co.			
,, 7.	St. Day United	10	5	3	4	...	—		... —	... 586	9	9
	,, ...	20	6	0	26	...	—		... Redruth	...1478	8	7
,, 10.	,, ...	31	12	0	7	...	—		... Chyandour.....	...2275	8	6
,, 11.	Great Work.....	34	0	0	16	...	—		... —	...1944	6	6
	Gurlyn	17	11	3	13	... 74	0	0	... Mellanear Co.	...1301	18	0
	Great Wh. Vor United	4	4	2	14	... 65	10	0	... Chyandour Co.	277	3	0
,, 13.	Great Wheal Fortune .	27	4	0	16	...	—		... —	...1946	9	9
,, 15.	Penhalls	4	11	0	9	...	—		... —	... 308	10	8
	Pedn-an-drea United ..	9	1	0	24	...	—		... Bissoe Co.	587	11	2
,, 17.	Wheal Vyvyan	1	2	1	13	... 66	0	0	... ditto	} 84	8	5
	,, ...	0	4	2	13	... 46	0	0	... ditto			
,, 18.	Wheal Grylls	21	10	3	15	...	—		... —	...1486	11	0
,, 20.	East Wheal Grenville..	4	0	0	19	... 70	0	0	... Bissoe Co.	280	11	10
	North Jane	1	9	1	23	...	—		... —	... 92	15	8
,, 22.	Great Wheal Fortune .	18	16	3	5	...	—		... Mellanear	...1375	6	0

Sundry Copper Ore Sales.

Date.	Mines.	Tons.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Mar. 3.	Laxey Mines (Isle of Man)	72	... 4	14	0	... St. Helen's Smelting Co.	338	8	8
,, 30.	,, ,, ...	50	... 4	13	2	... Pocketnook Co.	232	15	0
Apl. 6.	,, ,, ...	46	... 3	9	3	... ditto	172	17	6
10.	Lot 1 (John Peiles).....	76	... 15	19	6	... Newton, Keates & Co.	} 8,590	6	6
	2 ,, ...	76	... 16	5	0	... ditto ...			
	3 (Charlotte Clarke)	60	... 17	9	6	... ditto ...			
	4 ,, ...	60	... 17	15	0	... ditto ...			
	5 ,, ...	59	... 17	1	6	... ditto ...			
	6 ,, ...	59	... 16	19	6	... Evans and McBryde ...			
	7 ,, ...	59	... 17	1	6	... Newton, Keates & Co.			
	8 ,, ...	59	... 17	3	0	... ditto ...			
,, 16.	Lot 1 (ex Thelum)	8½	... 32	8	0	... Sims, Willyams & Co....	} 4,851	4	0
	2 ,, ...	19	... 31	15	0	... ditto ...			
	3 ,, ...	8	... 16	8	0	... ditto ...			
	4 ,, ...	65	... 20	1	0	... ditto ...			
	5 ,, ...	65	... 19	14	0	... ditto ...			
	6 ,, ...	64	... 19	13	0	... Evans and McBryde ...			

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Mar. 12.	Carmarthen United	36	14 0 0	Panther Co.	504 0 0
,, 24.	Treweatha	10¼	23 5 6	Treffry's Trustees	244 7 9
,, 26.	Westminster	16	12 18 6	Adam Eyton	206 16 0
	Maesysafn	100	13 5 6	Walker, Parker & Co.	1327 10 0
	Mount Pleasant	6	12 10 0	Adam Eyton	75 0 0
	Hendre Ucha	12	13 0 6	ditto	156 6 0
	Bryngwyn	8	13 13 0	Walker, Parker & Co.	228 5 0
	,,	8	14 17 6	Newton, Keates & Co.	
	Pool Park	42	14 2 6	Walker, Parker & Co.	698 5 0
	,,	8	13 2 6	ditto	
	Llanerchyraur	25	13 17 6	Newton, Keates & Co.	346 17 6
	Carrohan	15	12 10 0	Walker, Parker & Co.	187 10 0
	Roman Gravels	19	13 10 6	ditto	274 19 6
,, 28.	Herodsfoot	82	27 14 0	R. Michell & Son	2271 8 0
,, 30.	East Logylas	50	12 16 0	Sims, Willyams & Co.	640 0 0
	Glogfach	30	15 17 6	Adam Eyton	952 10 0
	,,	30	15 17 6	Mining Co. of Ireland	
	Cwmystwith	50	13 0 0	Sims, Willyams & Co.	1306 5 0
	,,	50	13 2 6	Walker, Parker & Co.	
	Goginan	23	17 10 0	Adam Eyton	597 15 0
	,,	11	17 15 0	ditto	
,, 31.	Bronfloyd	50	14 1 0	Sims, Willyams & Co.	702 10 0
April 2.	Dyliffe	67	12 15 6	Walker, Parker & Co.	855 18 6
	Isle of Man Mining Co.	50	22 5 6	J. and J. Williams	2684 5 0
	,, (silver chats)	30	15 4 6	ditto	
	,,	50	22 5 6	R. Michell & Son	
	Minera	100	13 12 0	Sims, Willyams & Co.	5505 3 0
	,,	100	13 12 0	ditto	
	,,	77	13 12 0	ditto	
	,,	110	13 13 6	Adam Eyton	
	,,	104	13 12 0	Sims, Willyams, & Co.	
	,,	12	12 0 0	Walker, Parker & Co.	
,, 9.	Talargoch (Maesyrerwddu)	69	14 0 6	ditto	2021 3 6
	,, (Coetia Llys)	78	14 5 6	ditto	
	Deep Level	6	11 16 0	Adam Eyton	70 16 0
	Brynford Hall	9¼	12 0 6	Newton, Keates & Co.	114 4 9
	Rhosesmor	8	12 10 0	ditto	100 0 0
	Parry's	30	12 18 6	Walker, Parker & Co.	387 15 0
	Bryn Gwiog	35	13 8 6	ditto	469 17 6
	Long Rake	15	12 15 0	Newton, Keates & Co.	191 5 0
	Merllyn	4	9 15 0	ditto	39 0 0
	Cefn Cilcen	10	12 16 6	Adam Eyton	128 5 0
	Holywell Level	8	14 14 0	Walker, Parker & Co.	117 12 0
	Pant-y-Mwyn	13	10 17 6	ditto	141 7 6
	Llangynog United	21	12 5 0	ditto	257 5 0
	Llanrwst	60	11 15 6	ditto	706 10 0
	Minera Union	12	12 11 6	Adam Eyton	150 18 0
	Rhosesmor	11	5 15 0	Newton, Keates and Co.	63 5 0
	Caeconroy	14½	14 3 6	ditto	205 10 9
	Wheal Mary Ann	40	26 16 6	Treffry's Trustees	1565 12 6
	,,	35	14 1 6	ditto	
,, 13.	Frongoch	130	12 13 0	Sims, Willyams & Co.	1644 10 0
	East Darren	75	15 15 0	Panther Co.	1181 5 0
	Cwm Erfin	25	15 17 6	ditto	956 17 6
	,,	35	16 0 0	ditto	
,, 16.	Dyliffe	78	12 8 6	Newton, Keates & Co.	969 3 0
	Dyfngwm	32	12 8 6	ditto	397 12 0
	Rhoswydol	6	11 13 0	ditto	69 18 0
,, 20.	Great Laxey	100	17 3 0	ditto	1715 0 0

THE

MINING AND SMELTING MAGAZINE.

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The Iron Manufacture of the North of England.

DISTRICTS OF CLEVELAND, DURHAM, AND CUMBERLAND.

By MM. Gruner and Lan.

(Abstracted from the *Annales des Mines*, 6th series, vol. i, p. 89.

Importance of the Region: The Northern Coal Field.

The coal-formation of the north of England is divided into two east and west branches, like that of the centre; but these two branches are very unequal. On the eastern side is the great basin of Newcastle, and on the western the narrow coal zone of Cumberland, skirting the sea, between Whitehaven and Maryport. Between these two rise up the waste table lands of Allenhead, composed of Millstone Grit and Carboniferous Limestone, containing lead veins.

Divisions of the Northern Field.—These two basins supply the iron works of the North of England, which may be classed into the three following districts:—

Cleveland (or Middlesboro'),
Durham (or Newcastle), and
Cumberland or North Lancashire.

The iron industry of the northern field differs in many respects from that of Staffordshire, of Wales, and of Scotland. While the Coal-measure ores abound in the three latter districts, forming the basis in the manufacture of pig-iron, they are almost entirely absent from the northern basin. In Cleveland the ore used is the Oolitic ironstone of the Lias, in Cumberland the red ore of the Carboniferous Limestone, and in Durham a mixture of these two ores with the Coal-measure ores or the spathic ore or brown hematite of the lead veins. Instead of raw coal, coke is exclusively employed.

The northern works produce specially forge-pig. The hematite

pig-metal of Cumberland, and especially that of Weardale, in Durham, made from the more or less decomposed spathic ores, is reputed to be of superior quality. The Cleveland pig-metal, although grey like that of Staffordshire, is much less tenacious and more impure. It is quoted at 1*l.* less than the ordinary metal of the central district, from 2*l.* 8*s.* to 2*l.* 10*s.*, instead of from 3*l.* 8*s.* to 3*l.* 15*s.* Cleveland also sells superior numbers as foundry-pig, but they are in much less demand than those of Scotland.

Number of Works.—The northern field comprises from thirty-five to forty works, with a hundred and twenty blast-furnaces. Its production of pig-iron amounts at present to from 700,000 to 800,000 tons, of which three-quarters are furnished by the Cleveland works.

Coal Formation of the North of England.—Before passing to the description of the iron districts, we shall say a few words on the coal-formation which supplies them with fuel. It is divided, as we have just said, into two unequal parts—the Newcastle and the Cumberland basins; the former annually producing from sixteen to seventeen millions of tons, and the latter one million. The details which follow relate principally to the Newcastle basin, but everything relative to the cost-price and to the nature of the coal applies equally to that of Cumberland.

The Newcastle basin extends, from south to north, from the valley of the Tees to that of Coquet. Its length is 50 miles, and its average breadth from 15 to 20. Its apparent area, not including the Millstone Grit, is 780 square miles. But to the east, between the Tyne and the Tees, the coal-formation dips under the Permian grits and limestones, and doubtless extends very far in this direction, for the workings of several mines have long been developed under these overlying deposits.

Number of Coal-Seams.—Forty coal-seams have been distinguished, of which eighteen are said to be workable; but these seams are far from being continuous, and never all exist through the entire extent of the coal-basin. In general, in the richest portions, there are rarely more than four or five seams of from 2 to 5 feet in thickness, and Mr. Buddle estimates that, on an average, taking the basin as a whole, not more than 12 feet of workable thickness can be calculated on. It will be seen therefore that the quantity of coal is not so enormous as is generally supposed; it is very much less than in Wales, where, over a much greater area, the workable thickness is almost double.

Production of the Basin.—As regards mere production, the northern basin is exceeded by that of the centre, but surpasses those of Wales and Scotland, as will be seen by the following figures:—

The central basin furnishes from 29 to 30 millions;
The Newcastle basin, from 16 to 17 millions;
The Scotch basin, 9 millions;
The Welsh basin, from 7 to 8 millions.

As to the specific production per mine, none can compare with the Newcastle basin. While the average per mine in all the United Kingdom is 22,000 tons; the average of the Newcastle basin reaches 55,000 tons.

Exports of the Newcastle Basin.—This basin also surpasses all the others in the quantity exported, which exceeds half the total exports of the kingdom. In 1858 it amounted to:—

Coal	3,542,922 tons.
Coke	207,103 „

Nature of the Coals.—The Newcastle coals occupy, from their nature, an intermediate position between those of Wales and Staffordshire. They are caking coals with a long flame, furnishing a silvery-white coke. These coals are equivalent with the caking coals of the basin of the Loire. To the south, in Durham, they are very soft and caking; while to the north, in Northumberland, they become harder and drier, and are more suitable for gas-works. Until within the last six or seven years the very small, obtained from screening, was at Newcastle, as in the central district, for the most part left on the waste heaps, or burnt in the open air as being of no value. At present, owing to the washing machine of M. Bérard, this small is cleaned and replaces in part the ordinary coal in the making of coke. The result has been a rise in the price of small, and a fall in that of large. In 1850, when the first iron-works were established at Middlesboro', the small was only worth at the pits from 3*d.* to 6*d.*, and now it ranges from 2*s.* to 2*s.* 9*d.*; while the ordinary large has fallen from 6*s.* 6*d.* to 5*s.* 6*d.*

Royalties.—In Durham, between the Tyne and the Tees, the coal royalties belong for the most part to the bishoprick of Durham. On an average a royalty of 6*d.* per ton is paid; but it varies, according to the situation and quality of the coal, from 4*d.* to 8*d.*; here and there it amounts even to 1*s.*, and some mines in the neighbourhood of Newcastle pay as much as 1*s.* 3*d.* In the southern part of Durham, which furnishes all the coal for the Cleveland works, almost all the mines are in the hands of one proprietor, Mr. Joseph Pease, of Darlington. He alone raises 1,200,000 tons per year. Still some of the principal ironmasters of the district—Messrs. Bolckow and Vaughan, of Middlesboro', the Derwent and Consett companies and that of Ferryhill and Tudhoe—have their own mines and raise the coal, either for their own use or for export.

Cost Price.—The cost-price of the coal, in the south and west of Durham, is extremely low at most of the mines. Owing to the soft-

Nature of the Coal.	Price at the Pits or at the neighbouring Works.	Price at the Works at Middlesboro'.
	s. *d.* *s.* *d.*	*s.* *d.* *s.* *d.*
Unscreened	3 6 to 4 0	4 9 to 5 3
Unwashed small..	2 3 „ 2 9	3 6 „ 4 0
Nuts	3 0 „ 4 0	5 0 „ 5 3
Ordinary lumps..	5 2 „ 5 6	6 6 „ 7 0
Superior lumps	6 9 —	8 0 —

The average distance from the mines to the works or to the port of export is 30 miles, and the carriage is ½*d.* per ton per mile, or 1*s.* 3*d.* for the entire distance.

ness of the coal it rarely exceeds from 2*s.* 9*d* to 3*s.* per ton.* The foregoing table shows the present selling price.

Durham is traversed by numerous railways. Besides the North-Eastern, the north and south trunk lines from London to Edinburgh, by Darlington and Newcastle, various branch lines, connecting the mines with the nearest ports, have been constructed for the carriage of the coal: thus in the valley of the Tees is the oldest English railway, from Darlington to Stockton and Middlesboro'. More to the north, various lines connect Stanhope, Weardale, Auckland, and the town of Durham with the ports of Hartlepool, Sunderland, and Shields; next, in the valley of the Tyne, is the east and west trunk line from Carlisle to Newcastle, extended as far as the ports of Tynemouth and North Shields. On the other hand there are few canals in this district; but vessels of light draught can at high water go up the Tees as far as Stockton, and up the Tyne as far as Newcastle.

Price of the Coke.—The coke is manufactured on the mines, either from the ordinary coal or from the washed small. The operation is generally conducted in ordinary round ovens like bakers' ovens. The coal yields on an average 55 per cent., and the coke is sold, according to quality, for from 8*s.* to 9*s.* The cost-price is made up as follows:—

	s.	*d.*
1 ton 16 cwts. of coal at 3*s.* 9*d.*	6	9
Cost of make	1	3
Cost-price on the mine per ton	8	0
Cost of carriage from the mines to the works at Middlesboro', a distance of 30 miles	2	0
Cost-price per ton at the Cleveland blast-furnaces ..	10	0
Or for superior qualities	11	0

The best coke, for cupolas or locomotives, is quoted f. o. b. at from 12*s.* 6*d.* to 14*s.*

Coal-Measure Ore.—The northern coal-basin contains, as we have said, very little ironstone. It is found, however, here and there towards the base of the formation, but the nodules are too scattered to be workable, unless occurring immediately at the roof of the coal seams. It is thus that in working the coal, there is procured from the Durham and Northumberland mines about 20,000 tons of carbonate of iron, which is smelted by the Derwent company in their blast-furnaces. It costs 8*s.* per ton, but this would be greatly increased if it were necessary to open special workings for its extraction.

The Cleveland District (Middlesboro').

Of the three northern districts that of Cleveland, although the most modern, is by far the most important. The works are grouped on the opposite banks of the river Tees, within a radius of five or six miles from its mouth. The greater number are situated on the right

* Throughout the Cleveland and Newcastle districts the legal ton of 20 cwts. is exclusively used. In the mines where the coal is soft a hewer breaks in a day from 6 to 7 tons. In the north of the basin the coal is harder, and consequently the cost-price amounts to 5*s.*

bank, between Stockton and Redcar, near the small town of Middlesboro'.

Number of Blast-Furnaces.—In 1860, the period of our visit, they amounted to:—

32 blast-furnaces south of the Tees.
16 „ north „

Total 48 forming 12 distinct establishments.

With these blast-furnaces are associated only two forges, that of Middlesboro' and that of Teeside, both near Middlesboro'. The forges are more numerous in Durham, near the collieries, while the blast-furnaces have rather been erected in the neighbourhood of the iron mines.

Special conditions of the Cleveland District.—The Cleveland mines are of very recent origin, the oldest dating back scarcely ten or twelve years, the period of the discovery of the Lias ore; but, owing to the abundance of this ore, the district has, in a few years, attained a very great importance. Everything has indeed combined to favour this rapid development. The ore crops out, in thick beds, in the eminences which border the sea, and is worked without shafts open-cast, or by simple levels. The Durham basin, of which we have just spoken, furnishes the fuel; and for forty years the oldest railway in the United Kingdom has carried its coal to Middlesboro', a distance of 30 miles, for the small sum of 1*s.* 3*d.* per ton for coal, and 2*s.* per ton for coke. Thus the blast-furnaces, constructed at the foot of the iron mines, found themselves already connected with the collieries, and in a position to export directly by sea their manufactured products. This exceptional situation threatened the other districts of the United Kingdom with ruin. Fortunately for them these favourable conditions are in part counterbalanced by the special nature of the ore. Much less reducible and less fusible than the Coal-measure carbonate, it is besides more phosphorised and quite as sulphurised, without, like it, containing as a corrective a large proportion of oxide of manganese. From these causes the Cleveland foundry-pig is less soft than that of Glasgow, without being more tenacious; and the forge-pig, although grey, is not suitable for the making of rails, or for irons or plates of ordinary quality. It cannot therefore in any case replace the forge-pig of the central district.

1. *Raw Materials.*

The Cleveland works procure their fuel and refractory clay from the Durham mines, of which we have just spoken, especially from those which surround West Auckland and the higher valley of the Wear. The ore comes from the Cleveland hills, at the foot of which are erected the blast-furnaces; the limestone from the calcareous table-lands of Stanhope and Allendale which separate the Newcastle basin from that of Cumberland: of all the raw materials used, the latter has to bear the most carriage, about 40 miles. We shall not refer again to the fuel of which we have already stated the source, the price, and the nature. There is nothing to say of the refractory clay,

the price and quality of which are about the same in all the basins. The following are the details respecting the ores—

Liassic ore.—This ore was discovered ten or a dozen years ago by the principal ironmasters of the district, Messrs. Bolckow and Vaughan, who had some years before established a forge at Middlesboro', for the treatment of scrap iron and the refining of pig-metal derived from various sources.

From the mouth of the Tees to Whitby, the sea is skirted by a series of flat hills, ranging east and west, with an average height of from 300 to 350 feet. At the base the Lias appears, towards the top the Lower Oolite, and halfway up, in the Middle Lias, a ferruginous seam 14 feet thick crops out. This is the Cleveland ore, formed of an intimate mixture of grey carbonate and of greenish hydrosilicate of protoxide of iron.* The seam, striking east and west, inclines at the outcrop 7 in 100 south, becomes horizontal under the centre of the hills, and then rises in an inverse sense and crops out again at a distance of 6 or 7 miles in the valley of Guisborough, which ranges east and west like the hills themselves. It is along these outcrops that the ore is wrought. The most important and oldest mine was opened by Messrs. Bolckow and Vaughan on the northern outcrop, near Eston, between Redcar and Middlesboro.' At the western extremity of the same outcrop is the mine of Bell, brothers, the proprietors of the five blast-furnaces of Clarence works, situated opposite Middlesboro,' on the left bank of the Tees. Lastly, in the valley of Guisborough, are the mines of Mr. Joseph Pease, the rich colliery proprietor of Darlington. Besides these, many less important mines have been opened to the east and west of them.

Quantity of Ore raised.—The whole of these workings furnish annually from 1,400,000 to 1,500,000 tons, of which half comes from Eston only, belonging to Messrs. Bolckow and Vaughan. We shall give a few details respecting this mine, the extent of which is about 2 miles following the direction of the seam, and 2½ miles following its dip.

Mode of Working.—In the first place the outcrop was worked open-cast, to an extent of more than a mile. At that period the ore only cost 2*s.*; but soon, owing to the steepness of the hill, it became necessary to lay open the seam by levels and headings. At present, besides a cross-cut drainage level, three large tramway-headings traverse the mine starting from the outcrop; each of which is provided with a fixed horizontal steam-engine of about 15-H. P., placed underground at a few yards below the surface. Each puts in motion an endless wire rope, guided by sheaves and pulleys, to which the waggons are attached. These headings, which are about 1,000 yards long, are not perfectly straight, and dip with an inclination of at most 2 or 3 in 100: they are lighted with gas all the way. These trains are composed of twenty-five full waggons coming up, and of as many empty ones returning; but it is said that this number might be increased to forty. Their rate of travelling reaches

* At 80 or 100 feet above the principal seam there is a second one, much thinner, containing nodules of a richer ironstone. It is being worked at points, and particularly for some time in the neighbourhood of Whitby.

from 8′ to 10′ per second. The waggons are of iron and rectangular in form; they hold about 1½ tons of ore, and weigh empty about 18 cwts. From the mouth of each of these three headings there is a self-acting inclined plane at the surface, from 500 to 700 yards long, which takes the ore to the bottom of the hill. Here it is emptied from the mine waggons into the railway waggons, on the branch line running into the Stockton and Darlington railway, whose various branches between Middlesboro' and Redcar directly serve to connect all the blast-furnaces on the right bank of the Tees. There is another branch in the Guisborough valley, for the purpose of connecting the blast-furnaces with the mines of the southern outcrop worked by Mr. Joseph Pease.

The method of working adopted at the Eston mine is very simple. The seam is cut out into blocks 30 yards by 10, by headings 3 yards wide, the length of the blocks being taken along the line of dip. The headings are in the first place driven 3 yards high following the wall; above which a yard of ore is left provisionally, inasmuch as it forms a better roof than the shales. The blocks are afterwards taken away, starting from the outcrop, by being again divided up by a series of workings at right angles to each other, very small pillars being left as supports. This method is economical but it entails a loss of a quarter of the ore.

This mine employs about four hundred miners and three hundred other workmen. The miners work two and two, and are paid 10*d.* per ton, out of which they pay for powder and candles, but not for the repair of tools. Each miner breaks about 5 or 6 tons, and gets from 3*s.* 6*d.* to 5*s.* per day. Per ton of ore broken one-fifth of a pound of powder is consumed. The timber used for propping, which is pine, is derived in part from the Department of Les Landes, by Bordeaux or Bayonne, and costs delivered at the mine 14*d.* or 15*d.* per foot.

Cost-price of the Ore.—The iron ore, loaded in the railway waggons, costs, including interest of capital, from 3*s.* 3*d.* to 3*s.* 6*d.* per ton, as follows:—

	s.	*d.*	
Breaking	0	10	
Tramming and accessories	0	9	
Wood and other materials	0	6	
Royalty	0	8	
Office expenses and interest of capital	0	5	to 6*d.*
Cost-price per ton	3	2	„ 3*s.* 3*d.*

The weekly production was 14,000 tons at the time of our visit. The greater portion is smelted in the sixteen blast-furnaces which belong to the proprietors of the mine. The rest is sold to the neighbouring works at 4*s.* 6*d.* per ton loaded in waggons. The nearest works are at a distance of 2 miles, and the furthest, 5 or 6 miles; the cost of carriage is 1*d.* per ton and mile. At Guisborough the cost-price does not reach 3*s.*, but the distance to the works is 10 or 12 miles. For this reason it is found preferable to calcine the ore on the spot, and to sell it in that state: the operation is conducted in kilns. The calcined ore is sold, delivered at Middlesboro', at 6*s.* 6*d.*

Nature of the Ore.—The Cleveland ore contains in a raw state from 29 to 30 per cent., and after calcining 40 per cent., the calcination causing it to lose 25 per cent. of its weight. The most striking characteristic of this ore is the great proportion of alumina which is as high as that of silica (from 8 to 10 per cent.), while in the Coal-measure ores it is generally comprised between ·30 and ·50 of the percentage of silica. This circumstance, added to the small proportion of manganese, explains the refractory nature of this ore.* It also contains iron pyrites which is found here and there in small irregular veins. But its most injurious constituent is phosphoric acid, the proportion of which varies between 1·5 and 2 per cent.; that is double or triple the amount contained in the Coal-measure ores. Towards the base of the seam the ore is particularly full of fossils which seem to increase the proportion of phosphorus. After this it is not surprising that the Cleveland iron should be all cold short.

Red Ores.—The Cleveland blast-furnaces in general only smelt the Liassic ores, of which we have just spoken; still some ironmasters, in order to improve their pig-metal, mix with them the red hematite of Lancashire and Cumberland. But as it costs 20*s.* per ton at the works it is very little used. According to Mr. Hunt's statistics the Cleveland district in 1858 only imported 11 or 12,000 tons; a tenth of the ore smelted.

Forge-Cinders.—Some ironmasters also charge forge-cinders; but in all cases only those from the heating furnaces, and always in very small proportion.

Limestone.—The Jurassic formation of Cleveland does not contain any calcareous deposits which are not argillaceous. The limestone for the blast-furnaces is derived from the Carboniferous Limestone, forming the table-lands of Stanhope and Allenhead, 40 miles from Middlesboro.' For this reason it costs 4*s.* per ton delivered at the furnaces.

2. *The Making of the Pig-Iron.*

Situation and Arrangement of the Works.—The Cleveland works are generally excellently although not luxuriously constructed, and are mostly on the same type. The blast-furnaces, exteriorly cylindrical, are enveloped in a mantle of iron plates. The most modern ones rest on columns; the others on four brick pillars, connected by conical arches.

The different furnaces of any ore works, generally ranged in a line, are connected two and two by iron bridges, but in other respects are entirely isolated.

Under the bridges are the hot-air apparatus, two for each furnace; and behind are the pneumatic lifts, one serving for two or three furnaces. On the right and left are the steam-boilers and blowing machines.

The gas is everywhere utilised, either for the boilers or for heating the air. Most of the throats are closed with the aid of a

* It is this same high proportion of alumina which renders the oolitic ore of Mondalazac, in Aveyron, and many of the ores of the department of Indre, so refractory.

movable distributor; at Teeside, however, a vertical cylinder fixed into the throat has been adopted.*

The Cleveland furnaces have generally only three twyers, the diameter of which is 4″; the pressure of the blast is from 2¾ lbs. to 3¼ lbs.; the temperature from 320° C. (600° Fahr.) to 350° C. (860° Fahr.). To heat the air the ordinary Calder apparatus with flattened syphons is used, or else, as at Clarence works, the apparatus with truncated syphons, with interior partitions. The blowing engines in most of the works are with upright cylinders and beams. The steam works at a high pressure and expansively. The blast-cylinders are of from 8′ to 10′ diameter and stroke, and the velocity of the pistons is 6½′.

Nature of the Pig-Metal.—The normal product of the Cleveland works is, as in Staffordshire, grey pig, properly so called. Nos. 1 and 2 are for foundry, and Nos. 3 and 4 for forge use.

Form of the Blast-Furnaces.—In order to obtain this pig-metal from the aluminous ores of which we have just spoken, neither the Welsh form of furnace with enlarged hearths nor still less that of the Glasgow district without hearths properly so called can be used. The old traditional form has been adhered to, particularly in respect of the boshes and a true hearth. To obtain, however, a very large production the body has been enlarged. This is nearly cylindrical excepting a rather sharp contraction towards the throat, with the view of facilitating the collection of the gases. Owing to the hardness of the coke and of the ore the height of the body can, without inconvenience, be carried as far as 50′ to 60′. The interior capacity measures from 200 to 230 cubic yards; some, like those at the Teeside works, go beyond 250 cubic yards. Such a blast-furnace, with all accessory apparatus, buildings, blowing engines, branch railways, &c., costs in Cleveland from 8,000*l.* to 10,000*l.*

The Cleveland ore calcined is less fusible but quite as reducible as the Coal-measure ore. With a given capacity of the body as great a production can be obtained as in Staffordshire, and in fact the ordinary furnaces of from 200 to 230 cubic yards produce from 20 to 26 tons, and those of 250 cubic yards a minimum of 30 tons, which corresponds to 8½ cubic yards per ton of pig in the twenty-four hours.

Consumption of Coke.—The infusibility of the aluminous gangue is shown by the weight of coke consumed, which is rather high for a calcined ore yielding 40 per cent. From 1 ton 10 cwts. to 1 ton 14 cwts. is consumed according as the metal is more or less grey; for the same reason the charge of limestone amounts to 14 cwts., and a dense blast and a high temperature are used. This powerful blast is however little favourable to the reduction of the silica, owing to the excess of alumina and lime. The Cleveland metal therefore is neither so siliceous nor so black as that of Glasgow; but on the other hand it is more phosphorised. As ordinary air would not in any degree remedy this latter inconvenience, the use of the cold blast has never been entertained: the pig-metal would be quite as impure with a much higher consumption.

* See *Mining and Smelting Magazine*, vol. i, Plate III, Fig. 7.

Slags.—The slags are entirely different from those of the other districts. They are always stony and short, and after cooling never present the enamelled tint, clear olive or apple green, of the manganiferous slags.

The Use of Forge-Cinders.—Some ironmasters are beginning to charge forge-cinders. When their use is confined to the cinders from the heating furnaces, which are not much phosphoretted, and when the proportion does not exceed from 5 to 10 per cent., the deterioration of the iron is not more sensible than in Staffordshire. Some masters even maintain that there is rather an improvement, which indeed may not be impossible, considering the aluminous nature of the ore and the siliceous character of these cinders.

Cost-Price of the Pig-Iron.—Of all the districts of the United Kingdom the economical situation of Cleveland is most favourable to the production of pig-iron. The cost-price per ton varies according to situation from 2*l.* 7*s.* to 2*l.* 10*s.*; but this price includes the interest of the capital employed, and often also a certain profit on the raw materials. If this profit and interest were deducted it would be seen that in reality the cost-price, calculated as in Wales, is not more than 2*l.* 3*s.* for forge-pig. In 1860, in one of the principal Cleveland works, we found the following details of cost:—

	Tons Cwts.	*s.*	£ *s.* *d.*
Calcined ore of 40 per cent.	.. 2 10	at 6	0 15 0
Coke	.. 1 12	„ 10	0 16 0
Limestone	.. 0 14	„ 4	0 2 10
Coal for engine and hot air	.. 0 10	„ 4	0 2 0
Labour (not including that for calcining and carbonisation) ..			0 5 6
Repairs, management, discount, &c.			0 4 0
Interest of capital			0 2 0
Cost-price per ton			2 7 4

But these figures may be reduced, even irrespective of the charge for interest of capital and the profit realised on the raw materials. If from 5 to 10 per cent. of forge-cinders are added, and if besides the object is to produce chiefly Nos. 3 and 4 for forge use, the consumption of coke would only be from 1 ton 8 cwts. to 1 ton 10 cwts., instead of 1 ton 12 cwts. The saving would thus be nearly 1*s.* on the ore and 1*s.* 6*d.* on the coke, reducing the cost-price to 2*l.* 5*s.* per ton.

Markets.—The Cleveland pig-metal is less sought for foundry use than that of Scotland, and is generally quoted at 3*s.* or 4*s.* less. In June 1860 the quoted prices f. o. b. at Middlesboro' were:—

	£ *s.* *d.*		£ *s.* *d.*
No. 1	2 10 0	No. 3	2 8 6
No. 2	2 9 6	No. 4	2 7 6

Nos. 5 and 6 (mottled or white), 2*l.* 6*s.* to 2*l.* 6*s.* 6*d.*

Generally only the three superior numbers are sold; the others are refined, in the district itself, for rails and common bars.

Part of the pig-iron is exported. Of late years Germany, and still more Holland, have taken the greater portion, France coming

third. According to Mr. Hunt the following are the exports from the Middlesboro' district:—

	1856.	1857.	1858.
	Tons.	Tons.	Tons.
Germany	21,159	20,034	8,331
Holland	9,584	22,840	30,129
France..	12,598	15,815	8,585
Other countries	6,466	11,211	8,948
Total	49,807	69,900	55,993

The pig thus exported is partly refined. France will doubtless import increasing quantities, but, we repeat, the wrought iron made from it, will always be of very ordinary quality, principally cold short, although sufficiently good for the making of rails.

Second-Fusion Pig.—The superior numbers of the Middlesboro' raw pig are mostly converted, in the district itself, by second melting in a cupola, into railway chairs and pipes. One establishment alone, that of Messrs. Bolckow and Vaughan, makes as much as 100 tons of chairs per day. The consumption, for the second melting, is 10 per cent. of coke; and in 1860 the chairs were sold at 30*s.* more than the raw pig, or 4*l.*: the pipes for from 4*l.* 15*s.* to 5*l.* 15*s.*, according to their dimensions and forms.

Profits.—The profits of the first Cleveland ironmasters were considerable from 1853 to 1857. Since then things have changed, and yet the conditions are now more favourable than otherwise, at least those of the principal works, whose proprietors also own coal and iron mines. So while the production has diminished in the other districts since 1857, in this one a continued increase is reported, excepting a slight falling off in 1858. The districts of Middlesboro' and Newcastle produced:—

	Tons.		Tons.
In 1857	527,600	In 1859	617,966
In 1858	499,800	In 1860	658,679

And this increase arises entirely from the Middlesboro' works. It is evident also that the production of these works is alone limited by the consumption; for there can be no falling off in either the ore or the coal for a long time to come.

The Durham District (Newcastle).

General Conditions of the Newcastle District.

The Durham district differs in many respects from that of Middlesboro'. It being supposed, *à priori*, that the carboniferous district of the north-east would prove as rich in iron ores as the other coal basins, some blast-furnaces were erected there, about the period when the iron works of Wales and Staffordshire commenced to develop themselves. But the clay carbonates being found wanting, almost all these furnaces remained idle, and their situation was not improved

until the discovery of the Lias ores of the Cleveland hills, and when, by means of railways, it became possible also to obtain the red ores of Cumberland and the brown hematites and spathic ores of the Carboniferous Limestone. From the fact of this situation the ore is dearer than at the Middlesboro' works, but, on the other hand, the coal is on the spot. Therefore, in fact, as regards the cost-price of the pig-iron, the difference is inconsiderable. But this iron must be wrought on the spot, for, taken for export in a raw state, it cannot compete with that of Middlesboro'.

The works of the Newcastle district are dispersed over the whole extent of the coal basin, and not, like those of Cleveland, concentrated round a centre.

1. *Works in Northumberland.*—There exist a certain number of works along the Tyne, near Newcastle itself, and further north in Northumberland; but these establishments are unimportant, being too distant from the iron mines to be successful. Thus out of eighteen furnaces, distributed among eight distinct works, six only were in blast in 1858, and their production did not exceed 45,000 tons.

2. *Of Durham.*—Between the Tyne and the Tees, in Durham itself, there are three principal establishments; which, taking them from north to south, are:—the works of the Derwent Iron Company, those of the Weardale Iron Company, and Witton Park, belonging to Messrs. Bolckow and Vaughan, the fortunate proprietors of the Eston iron mine.

3. *Of the Derwent Iron Company.*—The Derwent Iron Company possesses eighteen blast-furnaces, and a large forge of eighty-four puddling furnaces, for rails, large irons and common plates. The whole constitutes three distinct works near Shotley Bridge, Bradley, Crook Hall, and Consett.* The oldest, that of Consett, was erected not far from the western border of the coal basin, in the hope of finding the clay ore at the base of the formation. As is known this attempt failed and the company was ruined; and it is entirely owing to the discovery of the Cleveland Lias ores that the three works are at present in activity; but their position has been precarious since 1858, on account of their distance from the sea. In 1860 out of eighteen furnaces only eleven were in blast. The company itself possesses coal mines containing nodules of clay carbonated iron, but these can only be worked when found immediately in the roof of the coal seams. The blast-furnaces are only supplied with 15,000 tons of it, out of a total of from 200 to 250,000 tons of different kinds of ores annually smelted. The Coal-measure carbonate thus broken with the coal costs 8*s*.

The Cumberland red ore costs 20*s*. delivered at the works; the cost of carriage is 8*s*. for a distance of 120 miles by rail. The Derwent works smelt annually at most from 25 to 30,000 tons, but will consume more for the future. For the sake of reference we may mention the brown hematite of the Carboniferous Limestone. It is used only in small quantities because it is poor, in proportion to its price of 11*s*. per ton. It thus appears that four-fifths at least of the

* Consett was built in 1841; the two other works, after the discovery of the Lias ore; Crook Hall, 1850; and Bradley, in 1854.

ores smelted in the blast-furnaces of the Derwent Iron Company are furnished by the Cleveland mines. The distance is from 45 to 50 miles; the carriage is 3*s.* 9*d.*; consequently the calcined ore costs 9*s.* per ton.

The form and working of the Derwent furnaces differ little from those of Middlesboro.' The production is generally grey metal. Some furnaces however are charged with a high proportion of forge cinders, and in that case, like the Welsh works, furnish white pig more or less granular. The normal production is 20 tons per furnace, when charged only with Cleveland ores; from 25 to 26 tons when a fourth or a third of red hematite is added; and upwards of 30 tons when the charge contains from 20 to 30 per cent. of forge cinders. It will be seen from this that the quality, like the cost-price of the iron, varies within rather wide limits.

Cost-Price.—When the Lias ore is smelted alone the cost-price is made up as follows:—

	Tons.	Cwts.		*s.*	*d.*	£	*s.*	*d.*
Calcined ore	2	10	at	9	0	1	2	6
Coke	1	12	„	8	0	0	12	9
Limestone	0	14	„	1	10	0	1	3
Coal for engine and hot air ..	0	10	„	2	0	0	1	0
Labour	..	..		..		0	5	6
General expenses, including interest	..	..		..		0	5	0
Cost-price						2	8	0

As thus appears the conditions are a little less favourable than at Middlesboro'; and as there is, besides, the cost of carriage to the sea (4*s.* 6*d.* per ton), it will be seen that exporting, in competition with Middlesboro', is almost impossible under present circumstances. The pig-iron must therefore either be worked up on the spot, or the cost lowered by the addition of cinders. Both systems have been adopted simultaneously; thus, in 1859, out of a production of from 80 to 90,000 tons of pig-iron 25,000 tons of rails were made, 13,000 tons of large plates, and 4,000 tons of iron in bars.

4. *Of the Weardale Iron Company.*—The Weardale Iron Company possesses four works, all very modern ones: five blast-furnaces at Towlaw near Weardale; one at Stanhope; and two at Ferry Hill, built in 1860. Lastly, a large forge of sixty-four puddling furnaces, built about 1853 at Tudhoe near Ferry Hill. The make at these works is quite special. The Weardale company treat in their furnaces at Towlaw the spathic ores and brown hematites of the Weardale, Allenhead, and Alston Moor table-lands, &c.* They have the monopoly of all the ores furnished by the lands of the Bishop of Durham. These ores are very manganiferous, without phosphorus, and almost without sulphur, and contain less than 1 per cent. of alumina. They also smelt the red ores and some Cleveland ore, but only as an accessory. It will be seen from this that the Towlaw pig is specially adapted for manufacture into wrought iron. It is white, lamellar,

* These ores are furnished by veins which, in the Carboniferous Limestone, occupy a zone of 20 miles in length by 4 or 5 in width. The average distance of the mines from the blast-furnaces is from 10 to 12 miles.

and easily refined. Its cost-price doubtless exceeds by about 20s. that of the ordinary Cleveland pig, but it can be refined for fine iron and thin plates, which are superior to the best irons of Staffordshire; and even in applying the Lowmoor method products are obtained in no respect inferior to those of that establishment. The Towlaw pig-metal is also puddled at Tudhoe for steel, and, at the time of our visit, a Bessemer apparatus was being erected, it having been proved at Sheffield itself, that it was capable of yielding by that method good cast-steel.

The Weardale company sell but little iron in pig. Almost all that they produce is converted into wrought iron at their fine forge at Tudhoe, one of the best appointed that we saw in England. About 30,000 tons of wrought iron per year can be produced there, and of late years, besides fine irons, superior rails for Russia have been manufactured at 8*l.* 10*s.* per ton.

5. *Of Witton Park.*—The Witton Park works, in the valley of the Wear, above Bishop-Auckland, belong to Messrs. Bolckow and Vaughan. This establishment, erected since the discovery of the Cleveland ore, comprises four blast-furnaces and a large forge.* Lias ore exclusively is smelted there. Being situated 34 miles from the iron mines, the ore costs about 1*s.* less there than at Consett, and as the coke is almost the same price, the ordinary grey metal does not cost more than 2*l.* 6*s.*; which is a little less than at Middlesboro' but the carriage to the port is 3*s.* It is necessary therefore to refine the pig on the spot, which, besides, can be more advantageously done than at Middlesboro', owing to the vicinity of the coal mines.

Besides the thirty blast-furnaces of the three companies of Derwent, Weardale and Witton Park, Durham includes five other works with ten furnaces, without counting the sixteen on the left bank of the Tees, which we have included in the Middlesboro' district. Out of from 6 to 700,000 tons of pig actually produced per year by the two districts of Newcastle and Middlesboro', about 200,000 tons are furnished by the former.

The Cumberland and North Lancashire District.

We shall only say a few words on this third district, which may be said to be yet in a nascent state. We have stated that its ore is the red hematite; and we have spoken of its coal basin, which borders the sea from Whitehaven to Maryport. Until of late years almost all the ore of this district was exported into other districts. In 1858 there were only four blast-furnaces in Lancashire, of which one was worked with wood, and nine in Cumberland. Of these thirteen furnaces seven only were then in blast, and their total production did not reach 30,000 tons. Since then a large establishment of six blast-furnaces has been erected near the port of Barrow, in North Lancashire, whence the red ore of the district is exported to

* The two forges belonging to Messrs. Bolckow and Vaughan, that of Middlesboro' and that of Witton Park, include together 150 puddling furnaces; they can turn out per year nearly 80,000 tons of wrought iron.

South Wales. In Cumberland the two old works of Cleator Moor and Workington have also been resuscitated.

The ore of this district contains neither sulphur nor phosphorus, and very little alumina. It is specially adapted therefore for the making of forge-pig, and it is it principally which is at present converted by the Bessemer process into common steel at Sheffield. It is with this cast steel that boiler plates and railway points are made. The metal is obtained with hot air and costs at present at the Barrow works less than 3*l.* per ton. Owing to the new method of refining steel, and above all owing to the purity of the pig-iron, the Cumberland district is certainly destined to be largely developed, if the small extent of the coal basin does not prove an obstacle. A considerable increase in the production of pig-iron has been already reported. According to Mr. Hunt:—

	In 1859.	In 1860.
	Tons.	Tons.
Lancashire furnished	26,491	81,250
Cumberland „	50,097	87,750
Total production of the district ..	76,588	169,000

On the Manufacture of White Oxide of Zinc direct from the Ore.

By George Darlington.

The manufacture of zinc-white direct from the ores of zinc is an industry which has hitherto failed to have an existence in England; and the attempts which have been made to produce this pigment have invariably had their basis upon an arrangement dependent upon the use of a close vessel or retort, where the ore or metal and the products of combustion do not mingle. Thus the manufacture has remained an expensive one, and when carried out on a large scale, as in the Vieille Montagne works, the metal has been the foundation of the oxide. Upon this arrangement much ingenuity and money has been expended; but no attempt has been made to meet the objection of expense by a direct production from the ore in an open furnace, and under circumstances where retorts, and that homeopathic arrangement so peculiar to the metallurgy of zinc, should be done away with completely.

Perhaps the only valuable contribution which the Americans have made to the science of metallurgy has been in this particular branch of manufacture; indeed as regards the production of white zinc it must be confessed that they have brought it to a very high degree of perfection—if by this word we understand the production of an excellent commercial article at such a price as to leave perhaps the largest relative profit found in any smelting operation. Under these

circumstances we are not surprised that the make of zinc-white in America amounts to not less than from 8,000 to 10,000 tons annually. This large quantity found a ready sale previous to the outbreak of the present war at from 4¾ to 4⅞ cents per lb., or about 22*l.* per ton. But since the closing up of the Southern ports, not only have prices fallen to 4½ cents, or 20*l.* 10*s.* per ton, but sales have been effected with greater difficulty, and new markets have been obliged to be found for its consumption. Not one of the least important of these has been England, where a remarkable increase in sales has taken place during the last two years; and a colour which formerly had the strongest prejudices both of workmen and purchaser against it is really now regarded with a considerable degree of favour, and there is every reason to hope, from the tenor of feeling among painters, that if a moderate price can be relied upon, in a few years white zinc will have almost entirely replaced white lead for inside work.

Before considering the special metallurgy of white zinc, a few words may be said on its physical characteristics.—Firstly, as to body: no doubt the statements which have been current in respect of this fault have, as a general rule, strong grounds for foundation, and if they have been sometimes over estimated it cannot be denied that, compared with the first quality white lead, the balance in favour of the latter is as 11 to 7 or, as painters put it, three coats of white lead equal five of white zinc. But if we examine the respective work done, we cannot fail to admire the superior beauty and delicacy of the white zinc, either when laid on in "flatting" or "glossing," especially in the latter case; a superiority which is undeniable, and should of itself be sufficient to command the use of this paint for all inside work. This is indeed usually done, but in this way, that after the ground has been laid on in white lead, the surface is produced with white zinc. It has sometimes been supposed that violent compression would improve the body of the zinc oxide, but this is not so, and ought not to have been expected, as this quality is evidently dependent upon the molecular condition of the metallic base of the paint, which it is clear could not be readily altered by simple compression.—Secondly, in respect of its drying qualities: it has been stated that white zinc, probably from the excessive fineness and perhaps crystalline character of its ultimate particles, dries very slowly. Such is usually the case, and this has been attempted to be remedied, in coloured paints with a zinc base, by the introduction of litharge and even red lead; but by the use of these we at once get into difficulties, which have been sought to be avoided by the introduction of white zinc. It seems, however, that this objection is dying out, and in the oxide of zinc recently produced this difficulty does not appear to exist. It would seem that when the oxide is prepared moderately slowly, and at a low temperature, this objection is not found in the paint; but if a higher temperature, say that from the fusion point of gold to that of cast iron, be employed, then this quality begins to exist, while the "body" also apparently diminishes. This might possibly arise from the higher temperature causing a crystalline structure in the fine particles of the oxide of zinc.—Thirdly: some workmen object to grinding white

zinc, as it takes more time than white lead to prepare for the brush. This may be to a certain degree a valid objection, but it cannot be of much importance, as the proportion of time occupied in grinding bears but a small relation to that employed in laying on; and if in the works where the zinc is manufactured, grinding and mixing mills were erected, ready prepared paints might be sold, the cost of the preparation of which would only be very trifling.

In respect of the advantages of zinc-white over lead paints in a sanitary point of view, they are so acknowledged that nothing need be said about them; but I may observe that in carrying out my own experiments I have frequently taken into my system large quantities of this oxide, and the only inconvenience I ever felt was an irritation of the throat and nostrils, and after some days a slight soreness in the joints. Such a quantity of zinc as I took up in a day could not be inhaled by a painter in a month's steady business occupation. Further I have only to refer to the extensive employment of zinc-white on the Continent, especially in the government works in France.

The production of white oxide of zinc direct from the ore is one of the simplest processes in the whole range of metallurgy, and its collection is little less easy. The furnaces are somewhat similar to ordinary coke ovens in shape and appearance. The bed is rectangular with an area of about 30 square feet, and the fire grate and furnace bed are one and the same spaces. This bed is a grate of perforated iron bars or plates, about 7′ long by 4′ 6″ wide, lying over a closed ash pit, into which air is forced by a fan-blast. The furnaces are arranged back to back, and there is a general system of placing them six in a block for the facility of repair. There is an opening in the crown through which the oxide, as produced, as well as the products of combustion of the contents of the furnace, are conveyed away into the cooling flues, and from thence passed into the bag collecting rooms and chambers of subsidence. This constitutes the whole of the standing arrangements of the works. The furnaces have a door in front about 2′ long and 18″ high, for charging the fuel and ore. The crown is semicircular, and the arch of 9″ brick work. The materials used may be common fire brick, as the temperature at which the ore works is low.

The process is simple. The fire being lit in the furnace, and the heat well got up, about 2 or 3 cwts. of furnace clinker is thrown on the perforated grate, so as to form a protecting cover to it. A good fire is now got up in in order to heat the clinker thoroughly, inducing by this means a condition similar to that which would be found, had the furnace just finished working a previous charge. About 1½ cwt. of small anthracite coal, of a size not exceeding a chestnut, is scattered evenly over the area of the grate, and the blast gently turned on. The fuel rapidly gets to a white heat, when the charge is thrown in as quickly as possible, and the furnace door closed. During the charging, the blast plays through the mass very quietly, but as soon as it is concluded the blast is allowed to have its full force, and the first products of combustion escape into the air. In about three-quarters of an hour the mass begins to evolve a considerable amount of zinc, which, oxidising at the moment of produc-

tion, communicates a green tint to the flame from the furnace. The escape-flue should now be closed, and that leading to the collecting chamber opened. Previous to this, however, the gases are transferred into an arrangement, whereby they become oxidised to their final limit, so that any traces of hydro-carbon or volatile matter, or even small particles of carbonaceous materials from the furnace, are converted into their gaseous peroxidised conditions, and the colour of the oxide of zinc brought out. The products taken direct from the furnace, without being thus heated, give a yellow or greyish oxide which is darker in proportion to the richness of the ore. Such products can be afterwards calcined at a temperature of from 600° C. to 800° C., and a brighter colour produced; but even when most carefully treated in this manner they retain a dirty creamy tint. From the oxidising chamber a sheet iron tube (No. 8 or 10 guage) leads into the main channel, conducting the products from the furnaces into sheet iron flues, immersed in a trough of cold water; the object being to cool the gases and so render them fit to enter the collecting apparatus. This is a chamber filled with a cross network of flannel bags. The distributing bags are 2 feet in diameter, and 150 feet long, and commence in a nozzle proceeding from the sheet iron flue: their number depends, of course, on the quantity of products to be treated. They lie horizontally, and have vertical bags a foot in diameter suspended from the roof and terminating at their lower extremities in the 2 feet horizontal bags; these again, for the purpose of a perfectly equal distribution of their contents, are tied by short lateral bags opening one into the other. Their contents are from time to time taken away by small bags, which open into the 2 feet main bags, and hanging from their bottom, receive the oxide of zinc, as it falls down when the vertical bags are shaken.

The foregoing passage of the oxide from the furnaces into the collecting chamber varies in some respects from the American method, where the white zinc and the furnace gases passed first into a square chamber, through which, in some instances, water percolated. This involved a loss of oxide of zinc, but is still followed in one establishment which I have visited. After this the mixed products passed into a separating tower, where any small particles of dust or anthracite, carried over mechanically by the blast, were separated from the remaining matters. This separating tower was from about 60′ to 90′ high with an area of about 320 square feet in its middle section. It was divided vertically by a diaphragm of 9″ brick work, which was carried up to within about 6′ of the top of the tower, leaving a passage of that size from one-half of the tower to the other. The current of furnace products slowly ascends on the one side, depositing, as it does so, the bits of heavy material which cannot, by such a slow velocity of the current, be carried over the top of the diaphragm, and descends through the other half to the collecting arrangement. This tower I have obviated by a very simple arrangement of the sheet iron flues which lead from the furnaces through the water cooler alluded to.

In the meantime let us suppose that the process has been going on. The oxide of zinc is being evolved and the charge is in course of working out; but the contents of the furnace fuse together, and

form platy cakes, while the blast no longer penetrates the charge. To avoid this, it is from time to time broken up, about three or four times in the eight hours which it takes to work clean. At the end of this time, the slags will probably contain 3 per cent. of zinc, which can be extracted; but it appears more economical to let it remain. The richness of the slags in zinc very much depends upon the amount of silica and oxide of iron in the ore. If the first be in excess, a larger percentage will be lost; but if the oxide of iron be in excess, then the loss in zinc diminishes, the silica attacking the iron more freely than the zinc base. The slags generally form a well matted clinker, but complete fusion must, under all circumstances, be carefully avoided.

When the charge no longer gives off fumes of zinc, which, with an 8 cwt. charge upon a grate of 30 square feet area, will take place in from seven to eight hours after charging, it is withdrawn; but enough hot slags are left upon the grate to ignite the "coal bed" of $1\frac{1}{2}$ cwts. of small anthracite before spoken of. After drawing the dead charge, and before throwing in the coal bed, the holes in the grate should be attended to, and any fine dust left upon them stirred through. The tools used for this purpose are an 8′ and a 12′ chisel and a 10′ rake.

The charge should consist of raw calamine crushed to the size of horse beans, but certainly not less, and mixed with from 33 to 40 per cent. of anthracite of a size somewhat smaller than the ore: it should weigh about 8 cwts. Thus, a furnace may be said to work about $7\frac{1}{2}$ tons weekly. The process goes on uninterruptedly from Monday morning till Saturday evening, when the fires are allowed to die out until lit the following Monday at 3 A.M. There is no difficulty in keeping the mass in active ignition, and in working out the charge very thoroughly. This is best regulated by the quantity of fuel mixed with the ore, the coalbed serving only to give a start to the process. The total quantity of fuel used should not exceed 65 per cent. of the weight of ore. Too much importance cannot be attached to the quality of the anthracite used in this process. If it contains a large percentage of sulphur, or of volatile matters, no amount of care will produce a good white colour in the oxide. The fuel which I have used came from the neighbourhood of Swansea, but I am by no means sure that it is the best for the purpose. A refractory, hard, dry fuel is requisite, and such an article, at any reasonable price, must for this purpose be the cheapest. I have tried the best Kilkenny coal, but it is not equal to the Welsh, while its price is higher;—indeed I have generally found the analysis of Irish materials to be more favourable than the working of them has proved. This is particularly so with coal, of which I may instance the best Castlecomer coal, a clear, brilliant, dense and bright fuel, but which contained such an amount of sulphur as to preclude its use for the manufacture of any but second quality oxide.

The ores best suited to this process are poor oxidised compounds of zinc, containing from 18 to 30 per cent. of metallic zinc. Such ores cannot be profitably treated in the reduction furnaces in England. The cost of production of the oxide is after all the best test of the metallurgical success of the process. At present this is not

exactly ascertained, but it is sufficient to say that, if the manufacturer desired, he could, without loss, sell oxide of zinc made by this process for one-half the present price of the article. Upon this point when more extended results shall have been obtained, which will be the case before long, I shall have pleasure in laying them before the public.

Abstracts and Reviews.

PROFESSOR ANSTED ON BITUMINOUS MINERALS.

At the meeting of the Society of Arts on April 29th, an important paper was read by Professor D. T. Ansted, M.A., F.R.S., on "The Varieties of Combustible Minerals used economically, considered in relation to their geological position and relative value for certain purposes."

After referring to the great antiquity of the use of combustible minerals, the Professor proceeded to class them under the following heads:—

(1.) Anthracite, meaning the varieties of combustible minerals that consist of carbon only, with no appreciable percentage of hydrogen or oxygen. (2.) Coal, including those that contain so much hydrogen and oxygen as to burn freely with flame, but so little water and ash that they are available for getting up steam. (3.) Lignite, the varieties of coal in which the percentage of water is so large as to affect their value seriously as a fuel. (4.) Bituminous shale, including those mineral admixtures of clayey matter with carbon and hydrogen that are valuable for gas, and for distilling, especially at low temperatures. (5.) Mineral Oil, Bitumen, and Asphalte, names given to certain combinations of hydrogen and carbon, very abundant in certain localities, and recently found in large quantities in North America, but which, from their becoming fluid either at ordinary temperatures, or when heated, cannot be regarded as fuel in any proper sense.

1. *Anthracite.*—Texture often loose and rotten, but sometimes very compact, and even imperfectly crystalline. Does not take fire readily, but burns with an intense local heat—radiating heat badly, so that it is difficult to use for steam boilers or iron making; for either of which it requires a special adaptation affording a strong draught yielding a large and rapid supply of oxygen gas. Geologically it occurs among the coal-measures, though often below them; but there is little probability of its having been modified from coal by local heat, although the true theory of its origin has not yet been satisfactorily explained.

2. *Coal.*—The varieties of this—by far the most abundant, valuable, and important of the mineral combustibles—are many, from steam-coal, which (containing little hydrogen but still burns with some flame) connects it with anthracite, to jet, which is a variety of lignite. The coals converted by partial burning in a closed retort into the substance called coke, contain generally from 10 to 25 per cent. of volatile substance expelled in coking. The Newcastle varieties in burning become soft, swell and cake together—and are hence called *caking coals.* The Midland varieties retain their form unchanged during burning. Those containing least sulphur make the best coke; and the varieties richest in volatile matters are used chiefly in gas making, but in proportion to their excellence in this respect they fail in heating power. The "cannel" (or "parrot" of Scotland), which occurs among beds of true coal, is distinguished by the superabundance of gaseous matter.—In the British islands coal occurs more abundantly in rocks of

certain geological dates than in any other; but recent observation has shown that not only is there good coal of much older date than the oldest part of the Carboniferous period, but that almost all the rocks of the Secondary period contain it in one part of the world or another—and the Professor's own investigations have recently laid open a coal-field of undoubted excellence and very considerable magnitude, in Transylvania, belonging to the Tertiary period.* Since then, there is Liassic and Oolitic coal in very large quantity, some of it in England, although chiefly in the east of Europe, and in Virginia, in North America; since, also, there are deposits of true coal in the newer Secondary rocks of the age of the chalk, and good beds also of true coal of the Tertiary period, it is quite clear that there can be no necessity to resort to extraordinary conditions of the earth and its climate to account for the formation.

3. *Lignite.*—Most lignites resemble wood in texture, but a few have the appearance of the best coal when first taken out of the earth although the test of time never fails to bring out the truth. They are distinguished by their great percentage of water, which reduces their heating power below that of the most inferior coals. It is to be regretted that this, which is the only true practical distinction between lignites and coals, should be lost sight of by some geologists who have denominated Tertiary and even Secondary coals lignites, simply from their geological position.

4. *Bituminous shale.*—This intermediate class of minerals lies on the border-land between coal and shale, but generally contains so large a percentage of clayey substance that it belongs to the latter rather than the former. Some indeed touch coal, and samples might easily be obtained which would burn like coal; but all agree in refusing to coke, and retaining their slaty character after burning. These shales contain much carbon and hydrogen in their composition, although these elements are not combined to form true bitumen; but there exists a clear passage from mere mineral oils, through the shales that more resemble coal, to those containing less than 5 per cent. of oils of all kinds. The Professor gives an instance of a passage of this kind through thirteen varieties, ranging from American rock oils to the Tertiary shale, brown coal, and paper coal of Germany The richest bituminous shales are found in Scotland, with and amongst coal; and it is not unlikely that some of the partings between coal that have often been thrown away as worthless, are of the same nature. Under various names, such as Boghead coal, Torbane-hill mineral, and many others, these have become familiar and important, owing to the introduction of a method of distillation at comparatively low temperature, originally introduced in France more than thirty years ago.

5. *Bitumens.*—These include the rock oils of America, the mineral pitch of Trinidad and Zante, the Albert coal, and the Cuban chapapote.

Turning to the consideration of the geological position occupied by these various combustible minerals, the Professor remarks that there is no doubt that the coal measures have hitherto yielded the most numerous and the richest bituminous shales, as well as the largest and most valuable supplies of coal. Anthracite, steam coal, bituminous coal, cannel coal, Boghead and Torbane-hill minerals, are all of the same age. But, although this is the case in England, and, to a great extent, in Belgium, Prussia, France, Spain, and Bohemia, and in the chief American coal-fields, there are still marked differences in the position of the different minerals, and there are wide and important deposits of coal, some older, and others much newer. The Indian coal-fields are probably very new. The Virginian coal-fields have long been known to belong to the Secondary period. There are excellent Lias coals worked in various places on and near the Danube,

* See Professor Ansted's paper "On a Tertiary Bituminous Coal in Transylvania," in *Mining and Smelting Magazine*, vol. iii, p. 65.

in Hungary—there are Cretaceous coals in Hungary, and excellent Tertiary coal as well as lignite in the same country. It is also remarkable that, although in England and Scotland the valuable and rich bituminous shales are close to the coal, in France and elsewhere they are often altogether removed. The great deposits of bitumen in North America are below the bottom of the whole series. Rich beds of shale, yielding 50 per cent. of all kinds of oil, near Autun, in France, are far above the highest bed of coal—the Lias bituminous shales are quite unconnected with any workable coal seams, and so are those of Tertiary age on the Rhine. There is, then, no geological limit of the age for these minerals; neither is there any limit of colour and appearance. Many of the blackest shales are worthless, and some that are of a very pale brown are very rich—experience and analysis are required to form an opinion in any particular case.

As to economic value, the relative importance in this respect of the combustible minerals, of all of which carbon forms a large proportionate part, is not, on the whole, difficult to determine. Pure carbon does not afford the best fuel. Pure, or nearly pure carbon, such as is seen in some samples of anthracite, is, indeed, a very difficult and unmanageable combustible, and can hardly be regarded as an economical fuel at all. A coal containing a moderate percentage of oxygen and hydrogen gases, and a reasonably small percentage of ash, is the best for all purposes as a combustible. Some kinds, especially of the Newcastle coals, cake, or run into a kind of slag while burning; other kinds, such as Yorkshire and Lancashire coals, burn through without caking, and fall to a white and red loose powdery ash. None of them, however, retain their exact form when burnt, either in an open fire or in a retort. Most of the cannel coals, and those varieties called Boghead coal, and Torbane-hill minerals, are very valuable for distillation of all kinds, but they retain their form, and behave like slates in the retort. Some of them, however, are capable of being used alone as fuel. They are all especially rich in gases, paraffine oils, and lubricating oils, but their peculiar value in this respect is accompanied by a corresponding diminution of their value as true coals. The Lias coals of Europe and America, the Oolitic and Cretaceous coals, and such Tertiary true coals as are known, all resemble rather the Yorkshire and Lancashire varieties than the caking coal of Newcastle. Most of the French coals and many of the Belgian varieties are of the same kind. It is difficult to draw an exact line that shall separate the true coals from the richer, blacker, and more coal-like shales used for obtaining gas or paraffin oils, but it has long seemed to me that the slaty character recognized in burning, affords a good practical definition. Regarded as fuels, all the coals are exceedingly superior to lignites, for the reason, that the coals are almost entirely without hygroscopic water, while the lignites, without exception, contain a marked percentage. It is, however, clear that this is no very serious disadvantage when the object is to obtain the oils by slow distillation, and thus some of the poor paper-coals or Tertiary shales of Germany have been used with fair result for this purpose, although utterly unfit for fuel, while the richer shales attain a value very far exceeding that which could belong to them as combustibles. Still more are the non-combustible bituminous schists inferior to coal as fuel, though they possess great value for the purposes for which they are specially adapted. The minerals that may thus be used are so numerous, varied, and widely spread—many of them are so unlike combustibles, and the results obtained from them are so immediately valuable, that they may almost be regarded as a new source of mineral wealth. As, in the case of iron, we are now employing numerous varieties of ore formerly neglected and despised, so I feel that the time is not far off when the collection of shales for distillation will be an important occupation, not only in the British Islands, but in most other countries. Bituminous shales are far more common than is generally thought. In

limestone countries they are rarely absent, and they are hardly less frequently associated with clays. It is a point of considerable importance that some of the lignites may also prove available for distillation, but of this there is at present hardly sufficient evidence. The demand for light oils, for illuminating purposes and for paraffine, seems only limited by the price, and the manufacture is extending in most countries of Europe. It is certain that there is no geological period and no rock that may not contain useful minerals of this kind. Mineral oils and true bitumens are less common than bituminous shales, but they also are more widely dispersed than is generally thought, and when found in large quantity they possess great value.

The Professor summed up his paper with the following conclusions :—

1st. That the variety of combustible minerals available for practicable purposes is large, perhaps larger than is generally thought, and that such minerals form several significant groups. 2ndly. That they belong, all of them, to all geological periods, no one being of necessity limited to any part of the earth's history. 3rdly. That there is less advantage taken of many of them than their real importance deserves. And, 4thly. That much has yet to be determined as to the circumstances under which the organic kingdom of nature has been enabled to provide these large stores of carbon and hydrogen as mineral contributions to the well-being of man.

In the Discussion that followed the chairman (Sir Thomas Phillips), Mr. Thomas Sopwith, F.R.S., Mr. P. L. Simmonds, Dr. Milligan (of Tasmania), Mr. Paul, and some other gentlemen took part.

Mr. Simmonds referred to the continually growing importance of the combustible minerals, particularly coal. Year by year our export of that mineral was increasing, and last year it reached 8,300,000 tons, with a value of $3\frac{3}{4}$ millions sterling, and nearly two-thirds of this went to the Continent. Referring to the colonies, the examination of their resources in combustible minerals had not been so generally systematic as it might have been. The limits of the great coal-field of New South Wales, were at present imperfectly known, but it was found to extend into Queensland, and to reappear in Tasmania, although it had not been practically opened out in either of those colonies. The total coal product of New South Wales during the last ten years had been 1,780,000 tons, of which more than one-half had been shipped to India, China, and the neighbouring colonies ; and present appliances were equal to the production and shipment of 30,000 tons weekly—the average price of good screened coal being from 12*s.* to 14*s.* per ton. The still greater development of these resources was only checked by the want of miners.

Dr. Milligan stated that in Tasmania they had got three or four different sorts of coal : they had a good bituminous coal, seams up to 13 or 14 feet thick on the east coast, and an extensive deposit of anthracite at the southern end of the island ; while on the west coast they had a jet like lignite, and on the north coast, upon the river Mersey, seams of a highly combustible shale, yielding an impure gas. The coal beds have been very much broken up into isolated patches by the eruption of greenstone ; and in one place where the seam was 12 feet thick, it could be worked by an adit. On the east coast some mines have lately been opened out, and the commodore on the station had pronounced the coal to be promising for steam purposes. That of the Mersey river had also been found to be a good steam coal ; and although the anthracite of the south had not been extensively used, it was found to answer well in combination with wood. In the immediate vicinity of Hobart Town there was also a considerable area of coal in seams about 30 inches thick.

Mr. Paul referred to the essential characteristics of the combustible minerals belonging to the Carboniferous series. Taking, in the first place, those minerals commonly known as coal, there was the anthracite—the

free-burning "steam-coals" of the Welsh coal-field,—the coals of the Lancashire district and Midland Counties,—the caking coals of the Tyne district,—and the cannel coals of Scotland. Between well defined specimens of these there were great apparent differences, but a closer examination showed that those were only in degree. Coals might be found which, while presenting all the apparent characteristics of anthracites, more closely resembled bituminous coal in their composition. Between the bituminous coals of the Tyne district and the "steam-coal" of Wales there was, in many instances, no kind of difference in composition. Between the cannel coals of Scotland and the bituminous coals of Newcastle, the difference in composition was small as a rule, and there were cannel coals which approximated more closely to the coal of Newcastle and Lancashire than they did to the better and more characteristic varieties of cannel coal. The term bituminous, as applied to coal, properly denoted the existence in it of a substance capable of being volatilised by heat, and which, though not true bitumen, was analogous to bitumen; but this character bore no recognisable relation to the amount of hydrogen in the coal. The well-known steam-coals of Wales, such as the Resolven, Graigola, Merthyr, Llangennech, and others, were, in composition, almost identical with the Hartley coals. The practical difference consisted in their yielding different amounts of volatilisable substance when heated. The Welsh coals yielded but little; the Newcastle coals yielded half their weight in some cases. These volatile products being swept away from the furnace before there was time for their being rendered available as a source of heat, appeared at the chimney mouth as smoke. It was owing to this circumstance that in the examination of coal for the Admiralty, the value of the Newcastle coal was placed so far below that of the Welsh coal. A mistaken system of trial was adopted, and both kinds of coal were tried under the same conditions. The experiments subsequently made proved conclusively that the Hartley coals had a higher fuel value than was assigned to them by the Admiralty trials, and that they were, in this respect, equal, and in some respects superior to Welsh coal. Between the typical varieties of coal there were intermediate varieties so numerous and presenting such minute gradations of difference, that it was impossible to draw any absolute line; although it was convenient to use the term cannel coal, caking coal, free burning coal, &c., and to comprise the whole of the varieties of coal, excepting anthracite, under the term bituminous. Considering the applicability of a mineral as fuel, it was equally impossible to establish any absolute distinction between coal and those minerals associated with it, which were capable of being burnt, or which at least contained combustible substance; but which differed from what was practically recognised as coal, in containing a larger amount of earthy substance, and which were generally called bituminous shale. A mineral of this kind, containing 20 or even 30 per cent. of ash, might be used as fuel at the pits mouth, but it would not be sent up to London for use while other minerals could be got to send, that contained only 2, 3, or 5 per cent. of ash. In the absence of minerals of the latter kind, which were commonly called coal, and in the absence of other fuel, some of the bituminous shales, or such minerals as that of Boghead, might be used as fuel. Altogether the application of the term coal was merely conventional. But there were differences not hitherto regarded, and which might be made a means for determining coal from shale. It was, for instance, a recognised characteristic of coal, that it would leave when heated a fixed carbonaceous residue, called coke, amounting to a considerable portion of its weight. Coals varied very much in this respect; anthracite gave from 93 to 80 per cent. of coke. The Welsh steam coals gave from 80 to 70 per cent., while the Newcastle coals gave only from 70 to 60, and the cannel coals from 60 to 40 per cent. The Boghead mineral gave 30 per cent. of fixed residue. But this mineral contained 22 per cent.

of ash, while ordinary coal did not contain more than 5 per cent. of ash. Therefore, to find the difference between coals and other minerals, in this respect, the ash must be deducted, and the ratio of the fixed carbonaceous residue to the volatilisable portion ascertained; when there was a very marked difference recognisable. No true coal, as the term was generally understood, gave less than one-third its weight of fixed carbonaceous residue. Even the Albert coal of New Brunswick, which was in many respects exceptional, containing less than 1 per cent. of ash, and being applicable for the manufacture of oil and paraffine, yielded 33 per cent. of fixed carbonaceous residue, and 67 per cent. of volatile substances. Newcastle coal would yield 66 per cent. of fixed carbonaceous residue, and 37 per cent. volatile substances. The cannel coals, on the average, would yield half their weight of volatile substances, and an equal portion of carbonaceous residue. But the Boghead mineral would yield 88 per cent. of volatile substance, and only 12 per cent. of fixed carbon. Here was a wide difference from coal generally, and even from cannel coal. Certain bituminous shales again, that were not used as fuel, but for the manufacture of oil by distillation, would yield from 80 to 95 per cent. of volatile substance, and only 5 to 20 per cent. of fixed carbonaceous residue. It was a remarkable fact that the increase in the proportion of volatilisable substance, as compared with the fixed carbonaceous residue, bore a direct relation to the amount of earthy substance in the minerals. This was very noticeable in some of the poorer kinds of cannel coal, containing a large amount of earthy substance, or ash. The greater the amount of ash, the greater was the ratio of volatilisable substance to the fixed carbon. Another difference between coal and bituminous shale, consisted in the *nature* of the oily products obtainable from them, as well as their *amount*. Coal properly so called yielded oily products that were different in *kind* from those of bituminous shales and cannel coals that were most closely allied to bituminous shale. This was a most important distinction as regarded the manufacture of oil, and in reference to the question as to whether the Boghead mineral was a coal or a shale. The demand for oils distilled from bituminous shales, as a source of light, and for lubricating purposes, seems to be limited only by the extent of the supply. This manufacture had been carried on since 1833, in France and in Germany, and it was now being prosecuted in the neighbourhood of Linlithgow, with some shales occurring at Broxbourne; and at several other places between Glasgow and Edinburgh there were works of a similar nature.

BLACK AND CLAY-BAND IRONSTONES.

A very suggestive paper, on the distinction between these two classes of iron ores, was read in December last, before the Glasgow Philosophical Society, by Mr. James Napier, F.C.S., the well-known Metallurgical Chemist.

Mr. Napier first quotes Mr. Mushet's definition of black-band—which he describes as an ironstone that "may be considered as a species of coal which, when exposed to combustion, yields a greater or less quantity of smoke and flame, leaving behind what may be termed a metallic coke; the different beds of which generally contain a sufficient quantity of carbonaceous matter to torrify the stone, and make it fit for the furnace." From this definition is deduced the common rule for ascertaining whether ores are to be classed as clay- or black-bands—namely, whether they "contain sufficient carbonaceous matter to torrify them;" or, as Mr. Page states it,—"black-bands are those ironstones (clay carbonates) of the coal measures which contain coaly matter sufficient to calcine the ore without any artificial addition of fuel."

This method of distinguishing between such important ores, Mr. Napier

considers unsatisfactory. When it is remembered that the royalty for black-band is about double that for clay-band, there should be some more definite distinction even than the per-centage of coal; for the real per-centage of coaly matter required to calcine the ore will vary according to whether the coal is diffused equally through the ore or exists in bands or stripes. Besides, this method of classifying iron ores throws some very valuable ores into the inferior class of clay-band, as the following analyses will illustrate:—

	No. 1.	No. 2.	No. 3.
Oxide of Iron	38·8	53·0	40·8
Clay matter	17·0	2·0	10·0
Lime and Magnesia ..	12·0	5·0	2·0
Coaly matter	1·9	3·0	17·5
Metallic Iron ..	30·1	41·2	31·7

No. 1, clay-band; No. 3, black-band; No. 2 is a rich band, best of the three, and yet, by the above rule, is a clay-band.

As illustrating his views, Mr. Napier gives a series of analyses of various bands—some made thirty-seven years ago by Dr. Colquhoun, and other recent ones. The average composition of five specimens of these clay-bands was as follows:—

	Clay-bands, by Colquhoun (1827).	Recent Clay-bands.
Protoxide of Iron	39·7	42·6
Silica	11·8	7·4
Alumina	5·1	5·1
Lime	4·5	5·8
Magnesia	5·0	2·2
Coal	2·0	2·6
Metallic Iron	30·3	33·0

The next analyses are of four specimens of "striped ores," whose average composition was: protoxide iron, 46·5; silica, 7·7; alumina, 4·2; lime, 2·4; magnesia, 0·6; coal, 6·1; showing 36·2 per cent. of metallic iron. This shows a value very little above the clay-bands, certainly not so much above as to deserve double their price; particularly as such ores will require a good proportion of lime more than the clay-bands to make a good working slag.

Next follow analyse of five recent rich bands, to classify which among clay-bands, as the common rule necessitates, is, as Mr. Napier remarks, unjust. The average composition of these was: oxide iron, 53·6; silica, 2·3; alumina, 1·6; lime, 2·5; magnesia, 0·6; coal, 3·4; showing 41·7 per cent. of metallic iron.

After this follow analyses of four recent true black-bands by the common definition. The average composition of these was: oxide iron, 45·4; silica, 0·7; alumina, 2·7; lime, 1·0; magnesia, 0·3; coal, 23·0; showing 33·6 per cent. of metallic iron.

In the valuation of ironstones, Mr. Napier thinks there are considerations more important than the presence of a few per cents. more or less of coal. Coal is no doubt important; but the presence of certain earths that must pass through the smelting operations, is of greater importance directly to the smelter, as these earths have all to be fused, and often additional matters added in order to flux them, which have all a tendency to deteriorate the metal obtained. After giving several practical illustrations of this, he goes on to state his views that all iron ores have a relative value, depending on their composition, instead of a classification depending upon

a substance not essential to the smelter. To carry out this idea practically in estimating the value of iron ores he makes the following suggestions.

In the first place, all the earths in the ore are impurities, whether silica, al umina, lime, or magnesia—all of them add to the weight and bulk, and have to be fused to free them from the iron. He therefore proposes to deduct the average cost of fusing these from the value of the iron, and as large quantities of these deteriorate the quality of the m etal, the iron in the ore, by this method of valuation, is made cheaper to the smelter. For royalty the supposed value of the iron in the ore is taken at $1\frac{1}{2}d.$ per unit per ton, deducting $1d.$ per unit per ton for all the earths; and for sale, delivered free at furnaces, $4d.$ per unit per ton for the iron, subject to the same deduction for the earths. It must be understood that the prices assumed in either case are not taken as actual prices, but merely given to illustrate the principle of valuation adopted; which will be easily understood from the following examples:—

OLD CLAY-BANDS.

For Royalty .. { 30·3 per cent iron, at $1\frac{1}{2}d.$ = $45\frac{1}{2}$
26·4 „ earths, at $1d.$ = $26\frac{1}{2}$

19, or 1*s.* 7*d.* per ton.

For sale .. { 30·3 per cent. iron, at $4d.$ = $121\frac{1}{2}$
26·4 „ earths, at $1d.$ = $26\frac{1}{2}$

$94\frac{3}{4}$, or 7*s.* $10\frac{3}{4}d.$ per ton,
or 26*s.* $1d.$ per ton of iron per cent. in the ore.

RECENT CLAY-BAND.

For Royalty .. { 33·0 per cent. iron, at $1\frac{1}{2}d.$ = $49\frac{1}{2}$
20·5 „ earths, at $1d.$ = $20\frac{1}{2}$

29, or 2*s.* 5*d.* per ton.

For sale .. { 33·0 per cent. iron, at $4d.$ = 132
20·5 „ earths, at $1d.$ = $20\frac{1}{2}$

$111\frac{1}{2}$, or 9*s.* $3\frac{1}{2}d.$ per ton,
being 28*s.* $4d.$ per ton of pure iron in the ore.

EARTHY STRIPED BANDS.

For Royalty .. { 36·0 per cent. iron, at $1\frac{1}{2}d.$ = 54
14·9 „ earths, at $1d.$ = 15

39. or 3*s.* 3*d.* per ton.

For sale .. { 36·0 per cent. iron, at $4d.$ = 144
14·9 „ earths, at $1d.$ = 15

129, or 10*s.* 9*d.* per ton,
or 29*s.* $10d.$ per ton of pure iron.

RICH BANDS.

For Royalty .. { 41·7 per cent. iron, at $1\frac{1}{2}d.$ = $62\frac{1}{2}$
7·1 „ earths, at $1d.$ = 7

$55\frac{1}{2}$, or 4*s.* $7\frac{1}{2}d.$

For sale .. { 41·7 per cent. iron, at $4d.$ = 166·8
7·1 „ earths, at $1d.$ = 7·

159·8, or 13*s.* $3\frac{3}{4}d.$
31*s.* $11d.$ per ton of iron.

BLACK-BAND.

For Royalty .. { 33·6 per cent. iron, at 1½d. = 50½
4·7 „ earths, at 1d. = 4¾

45¼, or 3s. 9¼d.

For sale .. { 33·6 per cent. iron, at 4d. = 134·4
4·7 „ earth, at 1d. = 4·7

129·7, or 10s. 9¾d.
Iron 32s. 2d. per ton.

Looking upon these rich bands and the black-band, there is an apparent difference in favour of the rich band over the black, although the latter have coal sufficient to calcine it; but if we take the value of the iron in each, it will be found that the iron in the black-band is paid for at a higher rate, the difference being nearly equal to the value of the coal required to calcine the rich band. Again, the earthy or striped bands appear nearly of the same price as the true, or best black-band, although they have an additional 10 per cent. of earths; but the value of the iron is different; and, as observed already, in fusing 100 of the striped with flux, there will only be 50 tons iron, while the fusing of 100 tons of black-band gives 60 tons iron.

THE BOARD OF TRADE RETURNS.

The "Accounts relating to Trade and Navigation of the United Kingdom, for the month ended 31st March, 1863, and three months ended 31st March, 1863," have been issued by the Statistical Department, Board of Trade.

IMPORTS.—The quantities and relative increase and decrease of the imports of metals, metallic ores, and mineral products, for the month and three months ended 31st March, have been as follows :—

	Month ended 31st March.			Three Months ended 31st March.		
	1862.	1863.	Increase (+) or Decrease (−).	1862.	1863.	Increase (+) or Decrease (−).
Brimstone ... ... cwt.	95,235	126,000	+ 30,765	211,265	243,538	+ 32,273
Copper Ore ... ... tons	5,726	6,865	+ 1,139	18,173	15,661	− 2,512
Copper Regulus ... ... „	2,578	1,319	− 1,259	8,341	5,631	− 2,710
Copper, unwrought and part wrought ... } cwt.	32,480	28,220	− 4,260	62,500	48,700	− 13,800
Iron, in Bars, unwrought tons	346	880	+ 534	1,324	2,035	+ 711
Steel, unwrought ... „	1,102	191	− 911	1,251	292	− 959
Lead, Pig and Sheet ... „	1,814	3,135	+ 1,321	3,705	5,740	+ 2,035
Spelter or Zinc ... ... „	748	1,587	+ 839	1,432	3,478	+ 2,046
Tin, in Blocks, Ingots, Bars, or Slabs ... } cwt.	8,823	3,212	− 5,611	15,055	6,330	− 8,725
Silver Ore ... ... value in £	13,703	31,100	+ 17,397	103,151	57,740	− 45,411
Petroleum ... ...tuns	1,031	3,433	+ 2,402	1,717	4,760	+ 3,043
Quicksilver ... ... lbs.	38,500	79,157	+ 40,657	82,731	245,328	+162,597

EXPORTS.—The quantities, declared value, and relative increase and decrease of the exports of metals, minerals, and metallurgical articles of British and Irish produce and manufactures, for the month and three months ended 31st March, have been as follows :—

	QUANTITIES.				DECLARED VALUE.					
	Month ended 31st March.		Three Months ended 31st March.		Month ended 31st March.			Three Months ended 31st March.		
	1862.	1863.	1862.	1863.	1862.	1863.	Increase (+) or Decrease (−)	1862.	1863.	Increase (+) or Decrease (−)
					£	£	£	£	£	£
Alkali: Soda ... ...cwt.	209,215	186,320	462,434	476,826	82,989	77,130	− 5,859	186,085	198,283	+ 12,198
Coal, Cinders, and Culm ...tons	697,588	706,454	1,708,709	1,680,763	308,784	311,224	+ 2,440	782,002	765,536	− 16,466
Iron, Pig and Puddled ... ... „	37,177	39,905	87,667	93,659	98,105	110,970	+ 12,865	234,994	258,631	+ 23,637
Iron, Bar, Angle, Bolt, and Rod... „	22,571	24,728	59,579	71,802	160,748	196,312	+ 35,564	419,750	523,016	+ 103,266
Iron, Railroad, of all sorts ... „	26,722	31,039	64,945	84,208	198,818	225,496	+ 26,678	482,530	596,206	+ 113,676
Iron Wire, except Telegraphic.... „	674	1,824	1,629	4,887	18,678	38,817	+ 20,139	43,207	100,977	+ 57,770
Telegraphic Wire and Apparatus ... value in £	—	—	—	—	32,153	1,275	− 878	95,884	27,503	− 68,381
Iron, Cast ... ...tons	3,891	8,322	11,638	19,464	35,025	74,331	+ 39,306	113,814	166,831	+ 53,017
Iron Hoops, Sheets, and Boiler Plates ... ... „	7,393	10,098	16,800	26,102	73,892	117,809	+ 43,917	166,156	287,088	+ 120,932
Iron, wrought, of all sorts ... „	7,996	6,345	19,134	20,283	154,396	126,419	− 27,977	400,935	396,895	− 4,040
Iron, old, for re-manufacture ... „	1,710	2,695	2,652	4,380	6,329	9,673	+ 3,344	9,709	15,364	+ 5,655
Iron Steel, unwrought ... ... „	1,945	2,359	5,284	6,062	68,438	65,264	− 3,174	178,185	186,468	+ 8,283
Copper, unwrought, in Ingots, Cakes, or Slabs ... ... cwt.	9,582	29,731	21,072	44,867	46,345	136,630	+ 90,285	106,159	208,135	+ 101,976
Copper, wrought or partly wrought, Bars, Rods, Bottoms, Pans, Plates, Sheets, and Nails; and mixed or Yellow Metal for Sheathing .. „	44,696	50,897	82,301	105,735	214,413	230,547	+ 16,134	403,901	482,263	+ 78,362
Copper, wrought, of other sorts... „	2,703	1,075	6,511	2,442	16,325	6,704	− 9,621	42,137	14,604	− 27,533
Brass of all sorts ... ... „	2,444	3,554	7,875	8,638	14,429	17,645	+ 3,216	44,162	42,608	− 1,554
Lead, Pig, Rolled, Sheet, Piping, Tubing, and Lead Shot tons	1,818	4,692	4,786	8,731	41,188	102,898	+ 61,710	104,884	191,065	− 86,181
Lead Ore, Lead, Red and White, and Litharge of Lead ... „	870	510	1,938	1,210	19,502	12,616	− 6,886	44,204	28,737	− 15,467
Salt ... ... „	37,902	60,670	115,420	115,398	18,959	25,791	+ 6,832	57,353	51,852	− 5,501
Tin, unwrought ... ...cwt.	5,733	5,818	17,694	15,724	33,278	34,191	+ 913	105,856	91,068	− 14,788
Tin Plates ... ... „	121,027	93,537	259,543	239,441	142,998	110,187	− 32,811	306,321	279,602	− 26,719
Zinc or Spelter, wrought or unwrought ... ... „	12,397	8,336	26,833	19,725	11,182	8,130	− 3,052	24,978	19,909	− 5,069
				£	1,797,074	2,040,059	+ 242,985	4,353,206	4,917,641	+ 564,435

M. MOISSENET ON THE CORNISH METHODS OF DRAWING STUFF.

De l'Extraction dans les Mines du Cornwall. Puits inclinés et coudés. Par M L. Moissenet, Ingénieur des Mines. Paris: Dunod, Quai des Augustins, No. 49.

(*Continued from page* 282.)

IV. Chains, Flat and Round Hemp Ropes, and Round Wire Ropes.—In the matter of chains and ropes it will suffice to state their dimensions, weight, and the price of the principal kinds in use—their strength, and the mode in which they are employed in various mines.

I. *Dimensions and Price.*—1. *Chains.*—These are usually supplied by the foundries, and the quality of iron most employed is *Knight's extra refined.* The following table shows the price of chain of various sizes, and also that of the iron of which it is made, for the years 1855 and 1858:—

Diameter of Iron, in inches.	*a.* Price of the Chain per cwt.	*b.* Price of the Iron per cwt.	Difference *a*—*b*.
	s. *d.*	*s.* *d.*	*s.* *d.*
$\frac{3}{4}$	24 0	—	—
$\frac{11}{16}$			
$\frac{5}{8}$	25 0	18 0	7 0
$\frac{9}{16}$	26 6	18 6	8 0
$\frac{1}{2}$	28 0	18 6	9 6
$\frac{7}{16}$	29 6	19 0	10 6
$\frac{3}{8}$	32 0	19 6	12 6

In 1857 there was an increase of 6*d.* per ton in the iron, and 1*s.* in the chain. The St. Just foundry sells chains made of *Bradley's Bt. Pt. scrap iron* at the same price as those made of Knight's; and sells, at 5*s.* per cwt. extra, chains made of *Knight's Bt. Bt. charcoal iron.* We also in Cornwall meet with chains made of Staffordshire charcoal iron at 30*s.* per ton above the prices quoted in the table.

In deep mines the chains used are $\frac{9}{16}$", $\frac{1}{2}$", and $\frac{11}{16}$", either separately or combined: more rarely $\frac{3}{4}$" chain is used. For horse-whims $\frac{1}{2}$", and $\frac{7}{16}$" is used.

2. *Flat Ropes.*—For drawing, round ropes are only used with hand-tackles, and a small number of horse-whims; therefore there is only occasion for us to consider flat-ropes.

To make these it is usual to connect four round ropes, placed alternately with respect to their twist. The difference of price, as showing the cost of this connecting, is 2*s.* per cwt., whatever may be the size of the rope. The price of the latter, however, is very far from being as steady as that of chains, for it varies with the cost of the raw material. Thus, from 1855, the period of the Russian war, to 1858, it had fallen in the ratio of 2 to 3.

	1855.	1857.	1858.	1860.
Price per cwt. of tarred flat hemp rope ..	62*s.*	46*s.*	40*s.*	40*s.*

The size most usually employed is from 5" to 6" wide: the thickness of a new rope is $\frac{1}{4}$ of its width, but this is diminished as the rope becomes stretched.

3. *Round Wire Ropes.*—These ropes are not made in the county,* and do

* Wire ropes are at present manufactured in all varieties by Messrs. Stephens of Ashfield, near Falmouth.—Ed. M. & S. M.

not appear to have been introduced until about 1856, at South Frances Mine. They are usually procured from the manufacturers in London and the North of England, among whom there seems to be a considerable amount of competition. Messrs. Morton and Co., of Leeds, have deposited at the Truro Museum samples of their galvanised wire ropes, the make of some of which was as follows :—

$3\frac{1}{2}$″ girth—6 strands, each of 6 wires ; 3″—6 strands of 7 wires ; $2\frac{3}{4}$″, $2\frac{1}{2}$″, 2″, $1\frac{1}{2}$″—6 strands of 6 wires. Ropes for knocker-lines are made of 7 wires of various sizes—1, 0, 00, 0000.

The wire ropes usually employed are $3\frac{1}{2}$″, 4″, and $4\frac{1}{2}$″ in girth. All these sizes are sold at the same price—40*s.* per cwt., in 1858, which was the price of hemp rope.

II. *Weight and Strength.*—The weight per fathom of these various materials is not by any means constant, but varies with their mode of manufacture ; the same is the case with respect to their breaking strain. The following table contains the result of experiments made by order of the Admiralty :—

SIZE, WEIGHT, AND STRENGTH OF CHAINS AND ROUND WIRE ROPES.

Rope's Girth.	Chain's Diameter.	Weight per Fathom.		Breaking Strain.
		Ropes.	Chains	
Inches.	Inches.	lbs. oz.	lbs.	Tons.
2	$\frac{1}{2}$	3 14	16	6·35
$2\frac{1}{4}$	$\frac{1}{16}$	6 14	27	8·55
$2\frac{3}{4}$	$\frac{3}{4}$	7 4	31	10·20
3	$\frac{13}{16}$	8 8	36	12·00
$3\frac{1}{4}$	$\frac{29}{32}$	11 3	46	15·30
4	$\frac{31}{32}$	14 7	53	19·30
$4\frac{1}{2}$	1	16 7	58	21·50
$4\frac{3}{4}$	$1\frac{1}{16}$	18 12	62	24·40

The three following tables are taken from Messrs. Phillips and Darlington's *Records of Mining and Metallurgy*. Although they differ from that just given, which is worthy of the most confidence, they contain useful practical information, and are used by engineers. Indeed, in the Admiralty table the weight of the $\frac{1}{2}$″ chain is evidently exaggerated, for under no circumstances can it barely attain a weight of 15 lbs. per fathom. As to wire ropes, we know that their weight varies within wide limits, and it is prudent to take this as a maximum, while we take a minimum figure as their resistance. This is evident from the experiments made at Liverpool

CHAINS.

Diameter.	Weight per Fathom.
Inches.	lbs.
$\frac{7}{16}$	$10\frac{1}{4}$
$\frac{1}{2}$	14
$\frac{9}{16}$	18
$\frac{11}{16}$	27
$\frac{3}{4}$	32
$\frac{13}{16}$	37
1	56
$1\frac{1}{16}$	63

on ropes intended for marine purposes; for there it was found that the products of four makers varied for ropes of the same size, in their strength in the proportion of 15·0, 16·3, 19·35, 20·45. In these experiments the breakage usually occurred at the splices; and this mode of connection seems to deprive the ropes of 13 per cent. of their strength—but still it is preferable to a socket-joint, which weakens the rope by $\frac{1}{3}$. If we take Messrs. Phillips and Darlington's tables for the breaking strain of round wire ropes and flat hemp ropes, the working load will be $\frac{5}{36}$, or 15 per cent. in the case of the former, and $\frac{1}{9}$, or 11·11 per cent. in the case of the latter.

ROUND WIRE ROPES.

Girth.	Weight per Fathom.	Breaking Strain.
Inches.	lbs	Tons.
2	$3\frac{1}{2}$	7
$2\frac{1}{2}$	$5\frac{1}{2}$	11
$2\frac{3}{4}$	$6\frac{1}{2}$	13
3	$7\frac{1}{2}$	15
$3\frac{1}{4}$	10	20
4	14	28
$4\frac{1}{2}$	15	30
$4\frac{3}{4}$	18	36

FLAT TARRED HEMP ROPES.

Dimensions.		Weight per Fathom.	Breaking Strain.
Width.	Thickness.		
Inches.	Inches.	lbs.	Tons.
5	$1\frac{1}{4}$	24	$22\frac{1}{2}$
$5\frac{1}{2}$	$1\frac{3}{5}$	26	27
6	$1\frac{1}{2}$	28	32
7	$1\frac{7}{8}$	36	36

In practice mines replace chains, flat hemp ropes, and round wire ropes by each other in certain proportionate sizes of assumed equivalent strength. These equivalents are about as follows, with the weight of each per running hundred fathoms:—

Chains		Flat Ropes.		Wire Ropes.	
Inches.	Cwts. qrs.	Inches.	Cwts. qrs.	Inches.	Cwts. qrs.
$\frac{1}{2}$ ..	.. 13 $1\frac{1}{2}$	= 5 ..	.. 21 $1\frac{1}{2}$	= $3\frac{1}{2}$ ..	.. 9 3
$\frac{9}{16}$ ..	.. 16 3	= $5\frac{1}{2}$ ..	.. 23 1		
$\frac{11}{16}$ ..	.. 24 0	= 6 ..	.. 25 0	= 4 ..	.. 12 3
$\frac{3}{4}$ ..	.. 27 2			= $4\frac{1}{2}$ ..	.. 16 2

With the aid of these figures, and the prices given above, it will be easy to calculate the relative cost of these various materials for a shaft of any given depth.

In an economical point of view, however, it is more interesting to ascertain at once, by deducting the sums realised for old materials, the total sum expended per 100 fathoms, in the case of each of these articles.

III. *Cost per* 100 *Fathoms.* 1. *Chains.*—I estimate the loss on the wear and tear of chains at 30 per cent. of their weight new.

1. ½″ *Dolcoath.*

	s.	d.
Bought at 28*s.* per cwt.	28	0
Sold 2 qrs. 22 lbs. at 7*s.*	5	0
Expended per cwt.	23	0

Thus 100 fms. weighing 13 cwts. 1½ qrs., entails an expenditure of 15*l.*

2. ½″ *Botallack* (*Knight's Bt. Bt. Charcoal Iron*).

	s.	d.
Bought at 33*s.* per cwt.	33	0
Sold 2 qrs. 22 lbs. at 10*s.*	7	0
Expended per cwt.	26	0

Thus 100 fms. weighing 13 cwts. 1½ qrs., entails an expenditure of 17*l.* 11*s.*

3. $\frac{9}{16}$″ *Providence Mines.*

	s.	d.
Bought at 26*s.* 6*d.* per cwt.	26	6
Sold 2 qrs. 22 lbs. at 7*s.*	5	0
Expended per cwt.	21	6

Thus 100 fms. weighing 16 cwts. 3 qrs., entails an expenditure of 18*l.* 2*s.*

4. $\frac{11}{16}$″ *Dolcoath.*

	s.	d.
Bought at 24*s.* per cwt.	24	0
Sold 2 qrs. 22 lbs. at 7*s.*	5	0
Expended per cwt.	19	0

Thus 100 fms. weighing 24 cwts., entails an expenditure of 22*l.* 16*s.*

5. ½″ and $\frac{11}{16}$″ combined, *Dolcoath.*

Half of each size are used, but according to their respective duration (see further on), 75 fms. of ½″ are consumed against 25 fms. of $\frac{11}{16}$″, entailing an expenditure of 16*l.* 19*s.*

2. *Flat Ropes.*—The old ropes are resold for the manufacture of brown papers at about 7*l.* or 8*l.* per ton. Taking into account the wear and tear, this will be equivalent to a deduction of 5*s.* per cwt. on the original cost.

	s.	d.
Bought flat rope at 40*s.* per cwt.	40	0
Deduct for old rope re-sold	5	0
Expended per cwt.	35	0

1. 5″ *Drakewalls, Fowey Consols.*

100 fms. weighing 21 cwts., entails an expenditure of 37*l.*

2. 6″ *Carn Brea, Wheal Buller, Levant.*

100 fms. weighing 25 cwts., entails an expenditure of 43*l.*

3. *Wire Ropes.*—I have seen old ropes at the surface of several mines which have not been attempted to be made available; whatever the value

of these may be, it is largely balanced by the considerable amount of grease required to keep them in repair. Their cost per 100 fathoms is:—

	£
3½ inches, South Frances	20
4 „ Camborne Vean	26
4½ „ Levant, Great South Tolgus	34

IV. *Mode of Use, Load and Duration in certain Mines.*—On these points it will suffice, in addition to general statements, to select a few given examples among the deeper workings—where the load they can bear and their duration is of importance.

The weakening of chains is principally due to two causes—1. The great tension and jerks; 2. The friction on the rock. The latter, which is to a certain extent proportionate to the space traversed, principally affects that part of the chain which is nearest the kibble; the tension, on the contrary, is greatest nearest the engine. On the cages, particularly those which only allow of four turns of the chain side by side, the links are damaged in proportion to the weight of the load, and the smallness of the cages; so that, upwards, the wear is on the inside of the links, while towards the bottom the wear is on the exterior. These considerations have suggested various practices, more or less useful, as palliatives.

After six months' use, the chains are withdrawn from the shaft and rolled in a heap; then covered with a sort of cylindrical furnace and brought to a red heat. This is supposed to do away with the effect of the vibration, and the tendency of the iron to crystallise (North Roskear).

When a chain, the diameter of which is equal throughout its whole length, has worked in a shaft half the time of its total estimated duration, the lower half is taken up and is replaced by the upper half, which is itself replaced by a new one (Botallack).

Lastly, the chain may be composed of two halves of unequal diameter; and the large chain forming the upper half allowed to use out several smaller ones at the bottom (Dolcoath, Stray Park).

The principal shaft at Botallack, sunk at the bottom of the cliff, is 205 fms. deep, and the winding-engine is 40 fms. higher up at the top of the cliff. The length of the chain one way is therefore 245 fms. The drawing, which is by kibbles, is intermittent, reaching about 5,000 tons annually. The two lower halves of the chains, or 245 fms, are of a weight of 33 cwts., entailing an expenditure of 43*l.*

The maximum load supported by the kibbles is 41 cwts., made up as follows:—

	Cwts.
Weight of 245 fms. of ½-inch chain	33
Kibble loaded	8
	41

which amounts to 33 per cent. of the breaking strain given in the Admiralty table. The chain serves for two years.

At Dolcoath, in 1855, about 20,000 tons were drawn through two shafts, from an average depth of 250 fms.—the total depth being about 274 fms. They used one-half ½″, and one-half ⅛″; the expenditure on which, according to Capt. Charles Thomas, was as follows:—

	£	s.
Bought 12 tons 16 cwts. of ½-inch and ⅛-inch chain, at an average price of 26*s.* 6*d.* per cwt. ..	339	4
Sold old chain	63	10
Expended	275	14

This was probably made up as follows :—

Tons.	Cwts.		£	s.
8	0	½-inch chain, at 28s. per cwt.	224	0
4	16	1⅛ „ 24s. „	115	4
12	16		339	4

If we take 15 lbs. and 27 lbs. as respectively the weight per fm. of the chain, we find that these figures correspond to a consumption of :—

400 fathoms of 1⅛-inch chain.
1,200 „ ½ „

If we assume that the chain was equally divided between the two shafts it will suffice to consider them as one, in which there would be 600 fms. of chain, composed of two lengths of 150 fms. of 1⅛″ chain upwards, and two other lengths of 150 fms. of ½″ chain downwards. The large chain lasts eighteen months, and the small only six ; so that in a year each shaft consumes a quantity of the latter equal to its total depth, and a quantity of 1⅛″ equal to one-third of its depth—or 200 fms. of the latter against 600 fms. of the former. Doubling these figures we get the actual consumption. Each year, consequently, there is consumed four-thirds of the total length of this mixed chain—that is to say, a chain lasts, on an average, nine months.

The maximum load is 64½ cwts. made up as follows :—

	Cwts.
274 fathoms of composite chain	51
Kibble loaded (large size)	13½
	64½

which amounts to no less than 37 per cent. of the breaking strain of 1⅛″ chain, given in the table.

If we take 7s. per cwt. as the price at which the old chains may be sold, we find that the loss from wear is 30 per cent. of the weight new ; but the 70 per cent. of old chains sold only represents 18¾ per cent. of the original cost.

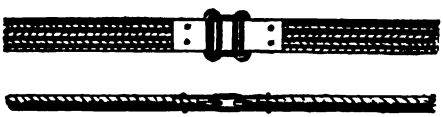
The friction of hemp and wire ropes against the sides of inclined shafts is a rapid cause of deterioration, against which it is necessary to provide as well as may be by the placing of rollers at the different elbows and changes of inclination. At Bottallack (Chycornish Shaft with flat ropes) these rollers are 20″ in diameter ; at South Frances (wire rop) they are only 12″. It is evident that there is an advantage in using as large rollers as can be conveniently adopted with ropes, particularly wire ropes, especially when the angle is considerable. This is also the case with sheaves at the surface. With chains, a diameter of 5′ suffices, but with hemp rope this is increased to 8′, and with wire ropes it is even pushed as far as 14′. If the engine allows of it, the cages, when wire ropes are used, have a diameter as large as the sheaves. Thus :—

South Frances : 3½-inch rope.	Sheaves	11 feet / 14 „	Cages 11 feet.
Camborne Vean 4 „ / Levant (1858) 4½ „	„	14 „	„ 14 „

Of the three materials, round wire rope is by far the least flexible, and the larger it is the more this is the case ; so that experience has shown that when it reaches 4½″ in an elbowed shaft, rollers are very insufficient preservaties, inasmuch as their diameter is always small in comparison to the sheaves.

The duration of hemp ropes depends a good deal on the air in the shafts; for when the latter is hot and humid it becomes very unfavourable to their preservation, of which we have an example in the United Mines, where, although the shaft is vertical, the ropes soon wear out. One of their advantages is that we see their wearing away, so that it is easy to replace in time any defective portion. The parts are usually joined together as shown in the following sketch.

FIG. 33.



At both ends of the ropes a certain length of chain is always attached, usually 3 fms. of double ½" (Wheal Buller); sometimes a single ¾" chain. At Drakewalls this chain is 60 fms. long; but here the distance of the water-wheel from the mouth of the shaft is such that on the arrival of the kibble at the surface the chain is still on the poppet-head rollers, and consequently has not to roll over the rope. This combination of two materials is rational, for it preserves the advantages of a compensating leverage on the cage, and leaves the chain to bear the friction of the shaft.

At Levant, 1857, the shaft was 240 fms. deep; and the drawing, in order to raise 10,000 tons from an average depth of 200 fms., occupied rather more than a third of the time. They purchased annually 150 fms. of flat 6" rope, which represents an average duration of three years and three months.* The maximum load, made up as follows was 79 cwts., or 12 per cent. of the breaking strain:—

	Cwts.
240 fathoms of 6-inch rope	59¾
Skip loaded	19¼
	79

At Fowey Consols one of the shafts reaches a depth of 330 fms., through which 14 or 15,000 tons a year are drawn from an average depth of 260 fms. The shaft is vertical, and the drawing, which is by kibbles, is continuous. The rope is 5" wide, and lasts, on an average, 18 months. The maximum load, made up as follows, is 82½ cwts., which equals 19 per cent. of the breaking strain:—

	Cwts.
330 fathoms of 5-inch rope	70
Loaded Kibble (maximum)	12½
	82½

At the United Mines, in a vertical and guided shaft of a similar depth, 19,000 tons are drawn from a depth of 240 fms. The rope is 6", which, with a maximum load of 16 per cent. of the breaking strain, only lasts a year.

At Devon Consols, where they use 6½" rope, the duration varies from eight months to twenty-four months—the average being twenty months. I am not aware of flat composite ropes of decreasing size having been yet used.

At Levant, in 1858, a trial was made of a wire rope, furnished by Morton

* Purchased from Mr. W. Carne, of Falmouth. The 150 of 6" rope weighed 39 cwts. 1 qr. 21 lbs., or 29·4 per fm.; and it cost, at 40*s.* per cwt., 78*l.* 17*s.* 6*d.*

and Co., of Leeds, at 40*s.* per cwt. It was 340 fms. long—280 fms. of 4½", weighing 45 cwts. 1 qr. 12 lbs., or about 18 lbs. per fm., and 60 fms. of 3½", weighing 6 cwts. 1 qr. 21 lbs., or 12 lbs. per fm. The 3½", which was first used for the ends, was soon abandoned, and the 4½" adopted throughout. Under these conditions the maximum load was only 12 per cent. of the breaking strain :—

	Cwts.
240 fathoms of 4½-inch wire rope	40
Skip loaded	19½
	59½

This rope worked for fifteen months, and could have been continued three months longer ; but the use of a hemp rope was resumed, as being more economical, as affecting the consumption of coal, in a shaft that, like this, changes its underlie four times.

At Camborne Vean the shaft is vertical for 30 fms., then underlies 15" in a fm. for 160 fms., is then again vertical for 10 fms., and lastly underlie" to the bottom (275 fms.) 5" or 6" per fm. in a different direction to the former underlie. The rope is 4" and working with a maximum load of 14½ per cent. will last, like that of Levant, only eighteen months.

At South Frances they draw from two shafts in conjunction : Marriott's shaft, which is vertical for 30 fms., and then underlies 18" in the fm. to the bottom (176 fms.) ; and Pascoe's shaft, vertical for 54 fms., then underlying 2′ in a fm. for 6 fms. ; again, vertical to the 84 fm. level ; and lastly underlying 2′ in a fm. from thence to the bottom (116 fms.) The quantity drawn in October, 1861, amounted to 1,100 tons from an average depth of 126 fms. At the deepest shaft the rope would have a maximum load of 14 per cent. of the breaking strain, made up as follows :—

	Cwts.
175 fathoms of 3½-inch wire rope	17½
Skip loaded with 17 cwts.	25½
	43

The rope at Pascoe's shaft had been in use three years, and seemed to be still in good condition. This case of South Frances is one of special interest, for it is cited in Cornwall as the best example of drawing appliances in the county ; and as this was the first mine where wire rope was used in the county, it is quoted as a proof of its success. But it must be borne in mind that results arrived at with a depth of 160 fms. are no criterion for judging results for depths of 250 fms., 300 fms., and upwards.

The preceding details, although incomplete, may be usefully generalised, particularly with regard to their bearing on drawing from deep shafts.

As regards load an effort is imposed which, in the case of chains, exceeds 33 per cent., or a third of the breaking strain ; which in the case of hemp varies from 12 to 19 per cent., against a co-efficient of work of ⅛ or 11 per cent. ; and which, lastly, in the case of wire rope is less than 15 per cent. or at least barely reaches it.

The partisans of chains are obliged, willingly or unwillingly, to abandon them for depths exceeding 300 fms. ; for in order to keep up the yield of the shaft the load of the kibbles or skips has to be increased, and continually heavier chains are required—which, independently of the inconvenience of an enormous ill-balanced weight, leads to frequent breakages showing that such an effort cannot be rationally pushed further.

As to wire ropes it has been judged prudent to keep at this side of the co-efficient. Thus in deep mines a 4½" size was adopted, which is equivalent, in respect of breaking strain, with a 1 1/16" chain. This exaggeration

was no doubt due to a certain anxiety as to the duration of the rope, which does not, however, seem to have been justified by experience.

Leaving on one side the economy of engine power, let us compare these three materials in respect of the absolute expenditure which their use entails. We have shown that a continuous working during a year will wear out a complete chain at a cost of 18*l.* per 100 fms.: if we admit an equal activity we shall find, from the figures given above, that the expenditure would be equivalent if—

Flat rope	5 inch	lasted	24 months.
	6 „	„	29 „
Round Wire rope	3½ „	„	13 „
	4 „	„	17 „
	4½ „	„	23 „

Referring to the preceding examples, and taking into account the weight drawn from a mean level, we shall see that the hemp ropes (costing 40*s.* per cwt.) have been everywhere less costly than chains; and that the 3½″ wire rope at South Frances alone shows any manifest superiority, while the 4½″ one of Levant is less economical than chains.

The expenditure for chain or rope forms a notable proportion of the entire cost of drawing, but when we have to choose between these materials we have to embrace many complex considerations, in which their mere cost is not the most important point. Still it may be well to state here that in vertical guided or non-guided shafts,, the conditions of which are not very unfavourable, and in guided shafts of varying inclination, the expenditure for hemp ropes will not exceed that of chains, if indeed it is not less. Round wire ropes, which in deep, but not very irregular, or in irregular, but not very deep, shafts, are advantageously employed of a moderate diameter, become costly, when, by reason of depth and irregularity combined, it is thought necessary considerably to increase their size.

Notes and Memoranda.

FREIBERG MINING SCHOOL.—It may not be generally known that, besides the famous Freiberg Mining College, there exists a local mining school, for the purpose of educating young miners to fit them for the position of mine-agents. A few particulars as to the working of this school may not be uninteresting at present, as several attempts of the kind are being made in the United Kingdom. The instruction is divided into four yearly courses, so that the pupils are expected to attend the school during four years. They do their day's work in the morning, and only study in the afternoon. The principal subjects are:—German, arithmetic, geometry, physics and mechanics, mining, mineralogy and geology, mineralogical practise, drawing, surveying, and book-keeping. The professors are:—Professor Neubert, for mathematics, physics, mechanics, mining, and surveying; Dr. Weisbach, son of the famous professor, for mineralogy and geology; Professor Heuchler, for drawing; and a master of the Freiberg Grammar School for German. The number of pupils is over seventy, comprising not merely young miners from the Freiberg district, but also colliers, particularly from Zwickau; and all are supposed to have first received a general elementary education.

ORIGIN OF MICA-SCHIST.—At a meeting of the Geological Society of London, on May 6th, a paper was read on this subject by Mr. H. C. Sorby, F.R.S., F.G.S. When ripples are formed whilst material is being deposited, there is a structure generated which the author has, in former papers, termed "ripple drift," and which he now described. This structure he stated might frequently be seen in polished sections of clay-slates, and also, in a form modified through metamorphism, in many mica-schists. From a consideration of the facts revealed by an examina-

tion of those rocks, he concluded that mica-schist is of sedimentary origin, metamorphosed after deposition, and sometimes after the production of cleavage and other physical changes, and that the bands of different minerals represent the planes of original deposition.

THALLIUM.—A new candidate for the honour of the discoverer of Thallium has appeared in the person of Mr. Joseph Jones, of Bolton-le-Moors, who claims to have succeeded in isolating the metal, which he called sulphurium, in June, 1857. He got this supposed metal from sulphur residues, and hence assumed that it was the metallic base of sulphur.

Patents relating to Mining and Metallurgy.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

March 16.—708. W. E. Newton, of 66, Chancery-lane, London, "improvements in the manufacture of iron and steel." From E. G. Boigues and P. Rambourg, of Rue St. Sébastien, Paris.

March 21.—753. I. M. Evans, of Cefn Mawr, Denbighshire, and W. T. Griffiths, of Merthyr Tydvil, Glamorganshire, "improved means for ventilating mines."

March 24.—771. S. Healey, of Elizabeth-street, Hackney-road, "improvements in the manufacture of zinc, and in the apparatus employed therein."

March 24.—772. H. Williams, of Portmadoc, Carnarvonshire, "improvements in machinery or apparatus for dressing slates."

March 24.—774. J. Kirkham, of Euston-road, London, "improvements in the manufacture of iron and steel."

March 25.—783. J. H. Johnson, of 47, Lincoln's-inn-fields, London, "improvements in the manufacture of zinc, and in the apparatus employed therein." From A. Muller, of Paris.

March 26.—788. R. Mushet, of Coleford, Gloucestershire, "an improvement or improvements in treating steel and iron prepared by the pneumatic process."

March 30.—818. Robert Mushet, of Coleford, Gloucestershire, "an improvement or improvements in moulds to be used for casting steel or homogeneous iron."

April 1.—841. W. Mitchell, of Carlton-hill East, London, "an improved process for coating iron." From J. Mitchell, of New York.

April 1.—843. E. B. Wilson, of Parliament-street, London, "improvements in the manufacture of iron and steel and other metals, and in the apparatus employed therein."

April 2.—853. A. P. Price, of Lincoln's-inn-fields, London, "improvements in apparatus employed in the fusion, manufacture, production, and refining of metals."

April 8.—884. J. Mosheimer, of Dolgelly, "certain improvements in machinery or apparatus for crushing, grinding, and dressing metallic ores, quartz, and other similar substances."

April 8.—891. A. Kinder, of Cannon-street, London, "improvements in coating or covering lead, or alloys of lead, with tin or alloys of tin, and in the apparatus employed therein."

April 9.—898. J. Rudley, jun., and D. McColl, of St. Helen's, Lancashire, "improvements in preventing the escape of fumes and matters from furnaces."

April 9.—903. G. Low, of Newark-on-Trent, "improved machinery for boring rocks and other hard substances."

April 11.—920. W. Clark, of 53, Chancery-lane, London, "improvements in separating ores from their gangues, and in apparatus for the same."—From L. N. Langlois, of Paris.

Feb. 9.—355. H. G. Williams and R. G. Price, of Bontddu, Merionethshire,

"an improved machine for crushing and amalgamating auriferous quarts, and pulverising and washing ores."

April 18.—972. C. W. Siemens, of Great George-street, Westminster, and F. Siemens, of Birmingham, "improvements in furnaces which are principally applicable to the smelting of iron."

April 27.—1,049. W. E. Gedge, of Wellington-street, Strand, "improvements in twyers or blast pipes, and in apparatus connected therewith."—From J. B. Monsallié, of Paris.

April 27.—1,053. F. Bennett, of Holywell, "improved method of condensing lead and other metallic fumes and vapours from furnaces."

April 28.—1,059. S. Ingledew, of Stockton-on-Tees, "certain improvements in the method of obtaining iron from its ore, and in the subsequent treatment thereof, for converting the product into a metallic state, and in apparatus connected therewith."

April 28.—1,072. G. E. Donisthorpe, of Leeds, "improvements in apparatus used when getting coal and other minerals."

April 30.—1,091. E. G. Brewer, of Chancery-lane, London, "improvements in welding and rolling metals, and in machinery connected therewith."—From M. Helson, of Hammont, France.

March 20.—742. W. Reay, jun., of Thropton Hill, Northumberland, "an improved machine for amalgamating minerals and other metalliferous and metallurgical products or substances."

March 28.—815. J. Dale, of Manchester, and G. Bischof, jun., of Swansea, "improvements in the manufacture of aniline, napthylamine, and other analogous bodies, and in apparatus connected therewith, which apparatus is also applicable to obtaining finely divided metallic iron for other purposes."

Notices to Proceed.

Nov. 19, 1862.—3,106. R. Mushet, of Coleford, Gloucestershire, "an improvement or improvements in the manufacture of cast steel."

Dec. 30, 1862.—3,472. J. H. Johnson, of 47, Lincoln's-inn-fields, London, "improvements in ingot moulds employed in the casting of steel and other metals." From H. U. Petin and J. M. Gaudet, of Rive-de-Gier, France.

Nov. 25, 1862.—3,159. A. L. Woolf, of Birmingham, "a new or improved metallic alloy."

Nov. 27, 1862.—3,176. J. Halford, of Great Barr, Staffordshire, "improvements in the preparation and treatment of small coal or slack, whereby a certain carbonaceous product is obtained and rendered available for use in the manufacture of iron and steel, in the processes of casting and moulding metals, and in the manufacture of paint and such like articles."

March 19, 1863.—738. J. Saunders and J. Piper, of Kidderminster, "improvements in apparatus employed in the manufacture of tin and terne plates."

Dec. 11, 1862.—3,322. R. Clark, of Langloan, Lanarkshire, "improvements in machinery or apparatus for boring, winding, and lifting for mining purposes."

Dec. 24, 1862.—3,438.—W. Henderson, of Glasgow, "improvements in obtaining iron and steel from certain ores and residual products."

Dec. 11, 1862.—3,320. J. R. Breckon, of Darlington, and T. Douglas, of Crooke, "improvements in the manufacture of firebricks and other articles usually made from fireclay."

Dec. 18, 1862.—3,384. J. Clayton, of Wolverhampton, "improvements in reverberatory furnaces for heating large masses of iron and steel, and in economizing the waste heat of the said furnaces."

Jan. 9, 1863.—84. M. Henry, of Fleet-street, "improvements in furnaces."—From H. Godard-Desmarest, of Paris.

Patents Sealed.

March 17.—2,626. E. Dixon, of Wolverhampton, "improvements in machinery and furnaces used in the manufacture of welded iron tubes."—(Sept. 26, 1862.)

March 24.—3,157. John Moule, of 15, Seabright-place, Hackney-road, "an improved method of deodorizing mineral oils and hydro-carbons."—(Nov. 25, 1862.)

March 24.—114. H. Bessemer, of Queen-street-place, London, "improvements in the manufacture and treatment of malleable iron and steel, and in furnaces, machinery, and apparatus employed in such manufacture.—(Jan. 13, 1863.)

April 6.—2,711. J. K. Hampshire, of Whittington, Derbyshire, "improvements in apparatus or machinery for washing coal, coal slack, and other mineral substances, and separating foreign particles therefrom."—(Oct. 7, 1862.)

April 6.—2,760. E. B. Wilson, of Parliament-street, London, "improvements in apparatus employed in the manufacture iron and steel."—(Oct. 13, 1862.)

April 13.—2,751. G. Harvey and A. Harvey, jun., of Glasgow, "improvements in boring machinery."—(Oct. 13, 1862.)

April 17.—2,831. S. Witham and T. Wright, of Calder Vale Ironworks, "improvements in the manufacture of iron and steel, and in the apparatus employed for that purpose."—(Oct. 21, 1862.)

April 17.—2,909. G. Darlington, of Minera, Denbighshire, "improvements in the manufacture of zinc oxide."—(Oct. 29, 1862.)

April 21.—2,913. W. Clark, of Chancery-lane, London, "improvements in the treatment of copper ores and in apparatus for the same."—From F. Le Clerc, of Paris.—(Oct. 29, 1862.)

April 21.—3,106. R. Mushet, of Coleford, Gloucestershire, "an improvement or improvements in the manufacture of cast steel."—(Nov. 19, 1862.)

April 24.—2,903. E. S. Tudor, of Upper Thames-street, London, "improveprovements in the purification of lead."—(Oct. 28, 1862.)

April 24.—3,021. E. Sonstadt, of Nottingham, "improvements in the manufacture of the metal magnesium.—(Nov. 8, 1862.)

April 28.—2,988. A. Wall, of Canton-street, Poplar, "improved processes for purifying lead and extracting and separating silver therefrom, and in machinery for those purposes."—(Nov. 5, 1862.)

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

March 19.—742. G. Crawshay, of Gateshead Iron Works, Durham, "improvements in the manufacture of iron pulleys for winding from coal-pits and other purposes."—(March 22, 1860.)

March 23.—826. W. M. Chambers, of Birmingham, "an improvement or improvements in the method of, and apparatus for straightening angle iron, and other bar iron of a trough-like shape after it leaves the rolls, and while still hot."—(March 30, 1860.)

April 10.—991. T. G. Dawes, of Wolverhampton, "improvements in working hammers by compressed air."—(April 20, 1860.)

PATENTS ON WHICH THE STAMP DUTY OF 100*l.* HAS BEEN PAID.

April 16.—923. W. Tytherleigh, of Birmingham, "a new or improved method of coating or covering iron or articles of iron with copper or alloys of copper."—(April 18, 1856.)

PATENTS WHICH HAVE BECOME VOID BY THE NON-PAYMENT OF THE DUTY OF £50.

March 14.—653. T. Morris, of Birmingham, "improvements in voltaic batteries, and in vats used in depositing metals by electricity."—(March 10, 1860.)

March 14.—666. W. E. Gedge, of 4, Wellington-street South, London, "improvements in apparatus for washing or dressing ores and analogous substances." From A. Dufournel, of Vassay, France.—(March 13, 1860.)

March 28.—748. G. T. Peppé, of Sydenham, "improvements in the manufacture of thin sheet lead coated with tin."—(March 22, 1860.)

March 28.—772. I. Blackburn, of Long-Eaton, Derbyshire, "improvements in the manufacture of iron and steel, and in making iron castings."—(March 24, 1860.)

April 11.—872. W. Parsons, of Swansea, "improvements in the manufacture of wrought iron."—(April, 5, 1860.)

April 11.—874. J. H. Johnson, of Lincoln's-inn-fields, London, "a new metallic alloy."—From C. Noel and Co., of Paris.—(April 5, 1860.)

April 18.—913. J. Webb, of St. Austell, "improvements in the cartridges employed in blasting."—(April 12, 1860.)

April 25.—1,036. A. K. Eaton, of New York, "a mode of manufacturing steel."—(April 25, 1860.)

PATENTS WHICH HAVE BECOME VOID BY THE NON-PAYMENT OF THE DUTY OF £100.

March 21.—633. J. Mitchell, of Dunning's-alley, London, "improvements in apparatus for washing and amalgamating ores and other matters."—(March 17, 1856.)

March 28.—736. W. Ball, of Chicopee, U. S., "improvements in machines for separating copper and other metals from their ores."—(March 27, 1856.)

April 4.—820. J. G. Martien, of Essex-street, Strand, "improvements in the manufacture of iron."—(April 4, 1856.)

April 25.—964. D. Lloyd, of Ebbw Vale Iron Works, "improvements in washing minerals, coal, and ores."—(April 22, 1856.)

COLONY OF VICTORIA.

Oct. 4, 1862.—403. S. B. Birkbeck, Queensland, and M. B. Pell, "an invention for extracting gold from quartz or other mineral substances with which it is found combined in the colony of Victoria."

AUSTRIA.

PATENTS DELIVERED IN JANUARY AND FEBRUARY, 1863.

Jan. 4.—2. C. Preisenhammer, "utilizing oxides of iron obtained in producing hydrogen gas for the manufacture of iron and steel."

Jan. 4.—6. C. Preisenhammer, "utilizing hydrogen gas for reducing processes at large."

Jan. 3.—7. G. Andreasi, "a malleable metal alloy resisting the action of sea water, being chiefly a substitute for copper in ship-building."

Jan. 16.—24. E. J. Gobiet, "an apparatus for collecting gases of blast-furnaces."

BELGIUM.

PATENTS DELIVERD ON THE 1ST APRIL, 1863.

March 10.—14,039. A. Namêche, of Brussels, "a system of tools and apparatus for working quarries, and for public works."

March 13.—14,055. A. H. Blochouse-Delcour, of Huy, "miners' lamps for burning mineral oils."

March 20.—14,083. A. Libotte, of Gilly-Charleroi, "a system of cleaning, puddling, reheating, and other furnaces."

March 20.—14,086. The Vieille-Montagne Company, represented by H. Renard, of Angleur, "a mixed furnace for reducing zinc ores."

March 20.—14,091. A. Muller and Co., represented by H. Biebuyck, of Brussels, "improvements in the manufacture of zinc in blast furnaces."

March 20.—14,092. T. Dofiny, of Gilly-Charleroi, "an apparatus for the traction of waggons in mines."

March 26.—14,121. E. J. Coates, "improvements in the treatment of white oxide of zinc."

April 1.—14,156. S. Davey, "manufacture of gunpowder for mining purposes.

March 30.—14,157. V. Bourg, "miners' lamps for burning mineral oils."

FRANCE.

Current List of Patents, 1862.

Sept. 6.—55,396. Alexandre, "manufacture of cast steel in reverberatory furnaces or common crucibles."

Aug. 30.—55,420. Perée, Callens, and Kinable, "a machine for extracting ores from mines."

Sept. 6.—55,539. Dubois-Caplain, "improvements in refining copper substances containing gold and silver."

Sept. 16.—55,607. Moreau, "smelting ores and metallic sands by means of peat, and manufacture of ore-cakes."

Sept. 20.—55,642. Verstraet and Olivier, "manufacture of carbonate of soda by using sulphuret of sodium."

Sept. 30.—55,693. Niel, "a crucible for smelting metals."

Sept. 27.—55,717. Glass, "improvements in the treatment of sulphuret of antimony, and in the mode of obtaining the products thereof."

Sept. 29.—55,751. Koch, "utilizing the residue from distilled Bog-head coal, cannel-coal, parrot-coal, and other similar coal for industrial purposes."

Sept. 23.—55,783. Langlois, of Paris, "an apparatus for separating ores from their gangues."

Oct. 3.—55,810. Fraquinet, "manufacture of flat and square, large and small iron, also sheet-iron for plating vessels, by means of ungrooved or so-called 'flat cylinders.'"

Oct. 6.—55,812. Lebaudy, "improvements in heating furnaces."

Oct 6.—55,846. Jordan and Gaulliard, "a metallurgic method for obtaining cast-iron, fine iron, and steel, from all kinds of pig-iron."

Sept. 29.—55,931. The Chantillon and Commentry Iron Works Company, "cutting out old rails and other similar iron, and converting the same into rod iron for trade."

Oct. 16.—55,981. Mushet, "improvements in means of lining and repairing puddling furnaces."

Oct. 21.—55,993. Delrieu, "a furnace for smelting steel in large quantities by means of a current of cold or hot air directly in a special puddling furnace."

Nov. 4.—55,998. Jacquet, sen., "a parachute for mines and quarries in case of rupture of the cable."

Oct. 24.—56,037. Leclerc, "treatment of copper ores, and especially the ores of Mouzaia (Algeria), by a dry process."

Oct. 22.—56,049. Wilson, "improvements in apparatus for the manufacture of iron and steel."

Oct. 25.—56,058. Dalifol, "improvements in apparatus for the manufacture of malleable pig-iron."

Oct. 29.—56,095. Grenier, "a cast-iron furnace without grate, called 'sulphuring furnace.'"

Oct. 27.—56,114. Wilden and De Cordemoy, "a direct process for reducing iron ores or cast-iron into cast-steel."

Oct. 30.—56,125. "A continuous or intermittent calcining furnace."

ITALY.

Patents delivered during the Fourth Quarter of 1862.

Aug. 1.—4. J. Biebuyck, "improvements in the manufacture of gunpowder for mining and other purposes."

Aug. 16.—6. E. B. Wilson, "improvements in apparatus used in the manuture of iron and steel."

Aug. 9.—9. G. R. Lescot, "an annular mode of boring rocks, hard stones, &c."

Sept. 4.—25. M. Falabrini, "an apparatus for extracting substances from mines, &c."

Aug. 28.—31. C. G. Schemman, "manufacture of raw, cast, and refined stee from all kinds of pig-iron."

Sept. 30.—41. D. Bolasco, "mannfacture of cement and cast-steel by means of various gases."

AMERICA.

PATENTS ISSUED FROM THE UNITED STATES PATENT OFFICE, 3RD TO 24TH MARCH, 1863.

37,803. F. Bennett, of Bagillt, England, "improvement in the manufacture of zinc."
37,888. A. W. Schell, of Clausthal, Hanover, assignor to G. Asmus, of Houghton, Mich., "improved shaking machine for separating ores."
38,003. S. W. Kirk, of Coatesville, Pa., "improvement in purifying cast iron."
38,016. T. Wise, of Boston, Mass., "an ore washer."

Mining, Quarrying, and Metallurgical Review.

WESTERN COUNTIES.

IN the metallic mining districts of Cornwall and Devon the past month has been characterised by unusual dullness. The depressed state of the copper standard, which as yet shows no signs of rallying, must seriously affect the position of the deep, costly, and large-producing mines of the county; on the other hand certainly the tin standard is healthier, and the recent rise is encouraging. In the absence of any material discoveries, therefore, dullness prevails.

Under these circumstances there is little to say. The only movement indeed of much importance in Cornwall is in the case of *West Chiverton*, a lead mine in the parish of Perranzabuloe, which for some time has been worked solely by the late Mr. Cookney. Upon the death of that gentleman, and since that of his son, Mrs. Cookney determined to realise the property, which was consequently sold to Mr. Edward Burgess and friends for the sum of 30,000*l.* This purchase included the two mines worked by Mr. Cookney—*West Chiverton* and *Chiverton*, the latter being the old Chiverton mine, worked many years ago by Mr. Stainsby, which had been recently commenced working by Mr. Cookney. Both mines have been divided into 3,000 shares; and as West Chiverton is quoted at upwards of 20*l.* per share (or 60,000*l.* for the mine) and Chiverton at 7*l.* per share (or 21,000*l.* for the mine), it seems that the purchasers of Mrs. Cookney's interest are realising 82,000*l.*, or 52,000*l.* profit. Of course this has to be divided among a good many, but still it represents a good pull to be realised in about a month. The 60″ engine now at West Chiverton is to be removed to make place for an 80″. Several other setts are spoken off as being about working in this, and the adjoining district of Newlyn. Among others, at *Wheal Trerew* it has been determined to erect a 50″ engine.

The falling off in the produce of *East Caradon* still continues, the last sale on the 21st realising 300*l.* less than that of April. The sales for the last nine months have been :—

	Tons.	£	s.	d.		Tons.	£	s.	d.
Sept. ..	454	3,219	13	0	Feb. ..	480	2,579	5	0
Oct. ..	476	3,348	9	0	Mar. ..	505	2,803	5	0
Nov. ..	480	3,472	13	6	April ..	503	2,428	1	0
Dec. ..	465	3,235	15	0	May ..	480	2,106	11	6
Jany. ..	475	3,441	11	6					

Thus since November, the time when we wrote an article protesting against the utterly absurd prices to which this mine had been "rigged" up—an article which of course brought down upon us the wrath of the share-jobbers and others who got up this "rig"—the monthly returns have fallen off

1,366*l.* 2*s.* and the profits from upwards of 1,000 per month to nearly 1,000*l.* This tremendous decline in returns and profits does not, however, by any means represent the extent of the delusion which was attempted to be palmed off on a credulous share-jobbing public. In the autumn of last year, when this mine was in the height of its returns, and the shares were selling for 55*l.* it was not merely stated that these returns would probably be continuous for a considerable time—which itself was obviously untrue;—but it was also asserted that this was only the beginning of enormously greater returns and profits. In a new article of the *Mining Journal* in the end of September last, after quoting the shares at 55*l.* the writer goes on to state:—"The mine is in its infancy as regards profits, and will *at once* greatly increase its returns. It has in it also more lasting qualities than any other mine in Cornwall. . . . We believe, therefore, that there is not a safer investment in the mining market, nor one more likely to continue increasing its profits for many years to come." These, it must be remembered, are not statements of opinion, but alleged statements of fact, not referring to some hoped for, but indefinite, future, but stated to be realisable *at once*. Yet within a little more than six months we find that returns have fallen off 40 per cent. and profits 50 per cent.! It was constantly reiterated statements of this kind which we, in common with every well-informed person in the county, knew to be as fabulous as Baron Munchhausen's adventures which by-the-bye were written on a Cornish mine), that induced us to attempt to point out their obvious fallacies. In doing so, of course we never hoped to influence the race of share-jobbers; but our protest at least served to show that, as far as the real mining interests of the county was concerned, they washed their hands of such concerns and their abettors.

The *South Frances* accounts, on the 4th May, showed payments by them of 3,112*l.* 6*s.* 9*d.* for costs and damages in their successful suit against *West Basset* against receipts on the same account of 1,852*l.* 1*s.*—thus showing a balance of loss of 1,260*l.* 5*s.* 9*d.* Thus they won their suit and lost upwards of 1,200*l.*—a mighty pleasant victory, and one admirably illustrative of the advantages of law. The other suit between these mines, in which the jury gave a verdict for West Basset, is still pending.

The following are the only noticeable alterations in mines:—At *Wheal Seton* the western winze has improved, and the 150 cross-cut north is worth, as far as seen, from 5 to 6 tons per fathom.—At *Emily Henrietta* the flat-rod shaft has improved to 15*l.* per fathom.—At *West Chiverton*, in the cross-cut at the 80, three good branches of lead have been intersected.—*West Polmear*, near St. Austell, is to be stopped.—At *Sithney Carnmeal*, in Bounder's shaft, the lode is from 4 to 5 feet wide, worth 14*l.* per fathom. As this is on the Carnmeal lode, which has made so rich in the adjoining mine of Great Fortune, great expectations are entertained.

At *Pendeen Consols* meeting on the 30th April, it was resolved that the contract entered into with Messrs. Harvey and Co., for a 32-inch stamping engine and stamps, for 1,450*l.*, be confirmed.—At *Great Wheal Busy* meeting on the 30th April, it was resolved the Boscawen mine should be constituted a separate sett, and divided into 6,000 shares, giving each shareholder the same number of shares as he now holds in the united mines. It was also decided that the general meetings shall in future be held every four months instead of quarterly as heretofore.—At *Grambler* and *St. Aubyn* meeting on May 5th it was resolved that the eastern part of the mine be suspended, and that the old mine be forked to the bottom and worked for tin.—At *Roskearnoweth* meeting on May 12, it was resolved that a new 60" pumping engine, and a whim engine, be purchased.—At *South Condurrow* meeting on May 13th it was resolved to give up the present lease, [illegible] had three or four years more to run, and to apply for a new one in part of their northern ground would be ceded to Condurrow, in ex-

ation of which they would have an accession of ground westward.—At *Wheal Trerew* meeting on May 23, it was resolved to erect a 50″ engine forthwith.

The only new concerns announced this month in Cornwall are the *North Wheal Ludcott* for working a sett a mile in length in the Liskeard district; and the *Grenville Delabole and Trehane Slate and Slab Company*, with a capital of 30,000*l.* in 10*l.* shares. Their object is the purchase and working of two quarries bearing the above names, situated in the parishes of St. Teath and Trevalga. The Grenville Delabole Quarry extends over 42 acres, and is held for twenty-one years, at 50*l.* per annum for the first seven years, 75*l.* per annum for the second seven years, and 100*l.* per annum for the remainder of term. The Trehane is upon a thirty years' lease, at a rental of 40*l.* for the first seven years, and 70*l.* for the remainder of the term. There is a royalty of 1-20th in addition to the rentals in each case. The Company will acquire the transfer of the leases for two hundred fully paid-up shares. The preliminary expenses are limited to 5 per cent. on the nominal capital. It is pointed out that the advantages of the quarries are a great abundance of superior slate metal a few feet from surface, a first-rate site for quarrying operations, an excellent fall for rubbish, and good roads from the quarries to the ports of shipment.

WALES AND THE BORDERS.

South Wales.—The trade of this district has been moderately active though perhaps not quite so much so as last month. Prices are unaltered, but it is hoped that there will soon be an improvement in this respect. A furnace lately put out at Gadlys for repair will, it is said, soon be rebuilt and lighted as soon as possible. It is also rumoured that the Pontnewydd tinworks, which have been at a standstill for two years, are to commence working very soon, and that the Cymbran forge has been sold or leased and will be in work without delay. The different iron works of the district have been regularly kept going, and the majority are fairly supplied with orders.

It is satisfactory to report that the tinworks of South Wales show signs of improvement and increased activity in the trade. Before the commencement of hostilities in America a large trade was done in tin-plates with that country, but since then the orders on American account have not been one-twentieth of what was formerly the case. As a natural consequence new markets had to be sought, and in this to a great extent the tin work proprietors have been successful. The result has been that additional hands have been employed at several works, and new establishments are able to be started. The Mellingriffith works, near Cardiff, after a stoppage of upwards of two years, have just commenced tin plating, and a good number of men are employed. A part of the old Llanelly ironworks, near Brynmawr, has been taken by Messrs. Jayne and Meadhouse, with the view of establishing a tin plate work. Increased activity is evinced at Pontymoile, Pontymister, &c., and the trade generally shows decided indications that a better demand exists for tin plates, and that the future looks promising.

The coal trade has been tolerably active and would have been much more so but for the scarcity of ships, which has seriously interfered with it, and many of the collieries have been only partially employed in consequence. A large contract has been secured by the proprietor of the Nantmelyn Colliery, which will keep the work going on full time for several months. The trade of the different ports for the month of April shows a large and substantial increase as compared with the previous or the corresponding month. During the month 511 ships, with an aggregate registered tonnage of 56,563 tons, cleared from the port of Swansea, and the shipping

dues received amounted to 1,301*l.* 10*s.* 3½*d.*, against 486 vessels with a tonnage of 52,950 tons, and 1,262*l.* 5*s.* 10½*d.* shipping dues in the corresponding month of last year, 26,859 tons of coal, coke, and culm, 213 tons of copper, 1,255 tons of bar iron, 359 tons of tin plates, and 683 tons miscellaneous were exported from Neath and Briton Ferry; and the imports were 4,401 tons of copper ore, 1,599 tons of pig iron, 5,813 tons of iron ore, 897 tons of pit and cordwood, 58 tons of timber, and 672 tons miscellaneous. A large export trade was also done at Llanelly, and Newport enjoyed a good coasting business, but the foreign trade showed no improvement. The import trade of Newport is fast increasing, more especially in timber.

At Cardiff there has been great activity in the shipments of both coal and iron. The exports over sea for the month were 128,541 tons of coal, 21,519 tons of iron, 387 tons of coke, and 1,901 tons of patent fuel, being an increase of 6,024 tons of coal and 8,831 tons of iron as compared with the previous month. The total shipments over sea for the four months of the present year have been 469,684 tons of coal and 56,404 tons of iron, against 424,394 tons of coal and 54,304 tons of iron in 1862, and 344,784 tons of coal and 47,771 tons of iron in 1861. These returns show a gratifying increase in the trade of the port.

The prospectus of the *Havan Silver Lead Mines Company of Cardiganshire* has been issued. The capital is to be 25,000*l.*, in shares of 5*l.* each.

GLOUCESTERSHIRE.—Among the imports into Bristol during the month have been: 92 tons of lead ore; 27 casks of metal from Rotterdam; coprolite from King's Lynn and London; pig-iron from Glasgow and Belfast; sulphur ore from Arklow; and 16 casks lead ore from Liverpool. Among the exports: 1,329 tons of iron; 219 tons of coal; 1,256 boxes tin-plates and 150 tons copper bars for Rotterdam.

MIDLAND COUNTIES.

STAFFORDSHIRE AND WARWICKSHIRE.—Trade in this district is still suffering from the effects of the puddlers not having yet returned to work, although, according to a proportion long established between the price paid for puddling iron and the official price of bars, the men are receiving rather more than they are entitled to, as the last reduction in the price of iron was not accompanied by any reduction in wages.

The demand for plates and angles for ship-building continues to afford a considerable amount of employment, but there is still an absence of specifications for large orders in this branch of the trade. There has also been more demand for hoops and sheets.

The coal trade has been tolerably brisk, especially for household sorts, and, although prices are not so high as they were a few months ago, still there is not a marked downward tendency. Native ironstone and gubbin have been in active request.

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—The iron trade in this district has been hardly so brisk as was the case lately. Consignments of iron to France have been few since the commercial treaty began to operate, and in the Rhine trade there is nothing doing. For manufactured iron, in the home trade, there has also been less demand, but the trade in pig, plate and angle iron continues satisfactory. At the Birtley ironworks, near Gateshead, much activity has prevailed; they include furnaces and forges, and are connected with the old and prosperous colliery of Ouston. The state of the blast-furnaces in the South Durham and Cleveland districts on the 1st instant are shown in the following table:—

Places and Owners.	In.	Out.	Total.
Eston — Bolckow and Vaughan	9	—	9
„ Clay Lane Company	3	—	3
„ Samuelson and Company	3	—	3
Cargo Fleet—Jones, Dunning, and Co.	2	—	2
„ Cochrane and Company	4	—	4
„ Gilkes, Wilson, Pease, and Co. ..	4	1	5
Middlesbrough—Bolckow and Vaughan	3	—	3
„ Hopkins and Co.	1	1	2
Port Clarence—Bell Brothers	5	1	6
Norton—Warner, Lucas, and Barrett	3	—	3
Stockton—Holdsworth and Company	3	—	3
Ferry Hill—J. Morrison	3	—	3
Thornaby—W. Whitwell and Company	3	—	3
Darlington—South Durham Company	2	1	3
Whitton Park—Bolckow and Vaughan	4	—	4
Stanhope—Weardale Iron Company	—	1	1
Towlaw—Weardale Iron Company..	4	1	5
Consett—Derwent Iron Company	5	13	18
	61	19	80
All places, May 1st, 1858	43	29	63
„ „ 1859	56	11	67
„ „ 1860	53	16	69
„ „ 1861	56	20	76

The coal trade continues much the same; some of the collieries are more briskly employed but the demand for household has been very dull.

The Custom-house returns for the North-Eastern ports for the month of April give the value of exports, other than coal and coke, as under:—

The Tyne, 120,130*l.*; Sunderland 6,017*l.*; the Hartlepools, 252,194*l.*; Middlesborough, 31,165*l.*; Stockton, 1,725*l.*; showing an increase of 33,881*l.* on the Tyne and 725*l.* at Stockton, and a decrease of 870*l.* at Sunderland, 339,280*l.* at the Hartlepools, and 2,731*l.* at Middlesborough.

The shipbuilding on the Wear has been very active. The chemical trade has been steady.

The exports from the Tyne during the month include:—173,731 tons of coal; 8,940 tons of coke; and 78,803 cwts. of iron. The imports comprise:—cargoes of pyrites from Seville, Pomaron, Huelva, Antwerp, and Levanger; sulphur and manganese from Rotterdam, Dordt, and Lajs; 1446 bars iron from Gothenberg; 3,180 bars lead from Carthagena; a cask of ore from Bergen; 100 kegs zinc nails from Antwerp; 8,000 pit props from Mandal; and silver sand from Antwerp.

SCOTLAND.

Only a moderate amount of business has been done in the coal trade at unaltered prices. The quantity exported during the month from the principal Scotch ports was 75,411 tons, against 89,325 tons during the corresponding period last year—showing a *decrease* of 13,914 tons.

The pig-iron market has been flat; and the shipments during the month show a decrease compared with the corresponding month of last year.

For all kinds of manufactured iron the market has been easier than for some time past. The demand for plate and other shipbuilding iron is good, but for common bars orders are not so plentiful, and prices have a downward tendency.

FOREIGN AND COLONIAL.

FRANCE.—There has been little doing in the Haute Marne district, and refined pig has been offered at 5*l.* 6*s.* per ton. The demand for iron has been very limited, and it is said that two small rolling works are about to suspend operations. The St. Jacques forge, at Montluçon, which for some time has only manufactured rails, has resumed the making of merchant's iron.

A company is being formed in Paris for the manufacture of an artificial manure, of which the Estramadura phosphate will form a chief element, a contract for its supply having been made with the owner of the quarries. This substance is represented as of extraordinary richness, containing not less than 93 per cent. of tribasic phosphate of lime, without the drawback of a proportion of carbonate of lime, the existence of which is said to restrict the use of the coprolites found in the neighbourhood of Strasbourg. Another substance which the Estramadura phosphate will probably supersede, owing not only to its superior richness, but from the proximity of the deposits to this country, is bone ash, now imported chiefly from the Brazils and the River Plate.

BELGIUM.—At Liège the demand for merchant's iron and plates has slightly improved. Rich coal continues in good demand, and all sorts required for manufacturing purposes are in active request. The Bois d'Haine blast-furnace has been relighted, and will replace in some degree that recently put out at La Louvière.

During the first three months of 1863, the exports of Belgian pig amounted to 8,269 tons, against 8,041 tons in the same period of 1852; the greater portion of this went to France.

Blast-furnaces at Marcinelle and Dolhaine are about to be relighted; and a new rolling works for fine plates is about to be erected at Montigny-sur-Sambre.

TUSCANY.—A prospectus has been issued of the *Terriccio Copper Mining Company of Tuscany*, with a capital of 50,000*l.* in shares of 2*l.* each. The object is to work a mining estate at Terriccio, about 20 miles from the port of Leghorn.

SARDINIA.—An influential company, called the *Pertusola Lead Mining and Smelting Company*, under the management of Messrs. John Taylor and Sons, has been formed with limited liability; the capital to be 250,000*l.*, in shares of 10*l.* each. Its object is to purchase eleven-twelfths of the well-known Monteponi Lead Mines, in the Island of Sardinia, with the extensive lead smelting establishment of Pertusola and the Sarzanello Coal Mine in the Gulf of Spezia; the company have also taken general powers for acquiring interest in mines, purchasing and smelting ores, and desilverising lead in Italy. The purchase-money is 150,000*l.*, which leaves 50,000*l.* for working capital, which is estimated to be necessary, and 50,000*l.* for contingencies and possible extensions. The property is said to be well situated, and has been favourably reported upon by one of Messrs. John Taylor and Sons' agents.

PRUSSIA.—From the statistics published, we find that the number of blast-furnaces in this country in 1861 amounted to 338, of which 234 were in blast. The production of pig-iron was 420,124 tons. The production of lead during 1861 amounted to 18,177 tons.

From the report published by the *Vieille Montagne* Company, it appears that the number of furnaces in activity during last year was twenty-six. The production of metallic zinc amounted to 77,466 ctr., of zinc-white 21,203 ctr. To produce this there was required a consumption of 411,826 ctr. of coal, 128,778 ctr. of blende, and 57,290 ctr. of calcined calamine. The average price obtained for the metallic zinc was from 5 to 6 thlr. per ctr., and for zinc-white 9 thlr. per ctr.

NORWAY.—A prospectus has been issued of the *Skara Silver Mining Company*, for working an extensive district about seven miles from the city of Kongsberg. The proposed capital is 50,000*l.*, in shares of 2*l.*, and the price to be paid for the mines is 15,500*l.*, of which 10,500*l.* will be in shares.

AUSTRALIA.—The last Australian mail brought advices from the Australian Mining Companies. The *English and Australian Copper* had three furnaces and one refinery at work at Kooringa, and three furnaces and one refinery at work at the Port Works. Since the date of the last advices further shipments of 73 tons of copper had been made to India and England.

At *Port Phillip and Colonial* the opening out of the mine is being proceeded with, the accidental damage done to the pumping machinery has been repaired. The improvement in the yield of the quartz observable at the latter end of last month has been continued, and there is an ample supply for present crushing power.

From *Yudanamutana* the reports continue satisfactory, and they hope by next mail to report having shipped 200 tons of copper ore.

From *Great Northern* they report having cut the lode in the 20 fm. level, but its appearance is unfavourable, being very much broken up and carrying no ore.

At *Scottish Australian* all operations, both above and below ground, were being proceeded with as rapid as practicable, but had been impeded during the month by heavy rains.

At *Worthing* the stopes are all looking as well as at last report. 150 tons of ore have been raised during the month. The smelting was going on regularly. There were 13 tons of copper and a large stock of regulus on hand.

At *Kapunda* all the operations were proceeding satisfactorily. The quantity of ore raised in January did not realize the estimate, on weight and assay amounting only to 15½ per cent. average produce, equal to 58 tons. The quantity raised in February is estimated at 205 tons. Since the date of the last advices 82 tons of copper had been shipped per Oscar for London.

From *Fortune* (Western Australia) they report having shipped 151 tons of copper ore. Since last report 35 tons of copper ore and 70 tons of lead ore had been dressed, and 28 tons of copper ore forwarded to Champion Bay.

The advices from Adelaide state that copper continued at 91*l.* per ton. Burra Burra shares were at 95*l.* ex. div.

Record of the Mining and Metal Markets.

METALLIC-ORE MARKETS.

TIN.—The tin standards advanced on the 26th 4*l.* for Fine, and 3*l.* for Second Fine and Common, and now stand at—

Superior Fine	.. £114	Superior Common	.. £109
Second Fine	.. 111	Second Common	.. 108

Although there has been no official alteration in the standard in the early part of the month, yet there practically was a fall in prices, for while,

towards the end of April, all the smelters readily gave more than quoted rates, they declined to do so about the middle of the month. The advance on the 26th was an agreeable surprise.

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard have been as follows:—

Date.	Tons.	Produce.	Fine Copper. Tons. cwt.	Price per ton.	Standard.
Apl. 30. ..	2,950 ..	6⅛ ..	196 0	£4 15 0	£113 2 0
May 7. ..	3,652 ..	7⅛ ..	261 5	5 3 6	110 14 0
„ 14. ..	2,971 ..	6¾ ..	202 5	4 16 0	111 1 0
„ 21. ..	6,146 ..	5⅞ ..	363 14	4 3 6	117 3. 0

At the sale of the 30th the standard declined 1*l.* 10*s.* At the sales of May 7th and 14th it slightly declined; and at the sale of the 21st it slightly advanced.

LEAD.—Comparing this month's sales with those of last, we find that prices have slightly declined.

COAL MARKETS.

LONDON, *May 29th.*—From the returns of the Registrar of the London Coal Exchange, of the quantity of sea-borne Coal, Culm, and Cinders, imported into London in the month of April, we learn that the total quantity was 233,274 tons, against 272,584 tons during the corresponding month of last year, showing a *decrease* of 39,310 tons.

The following are the particulars of the 233,274 tons imported during April:—

Newcastle ..	79,302	tons, in	203	ships	Scotland ..	1,225	tons, in 7 ships
Seaham ..	18,193	„	73	„	Wales ..	8,070	„ 19 „
Sunderland .	70,274	„	169	„	Yorkshire ..	2,848	„ 28 „
Middlesbro'.	4,935	„	18	„	Small ..	1,196	„ 5 „
Hartlepool..	45,459	„	154	„	Cinders ..	841	„ 12 „
Blyth ..	931	„	4	„			

The quantity of coal imported by railways and canals during the month of April was 117,098 tons, against 105,388 tons during the corresponding month last year—showing an *increase* of 11,710 tons.

The London Coal Market has been fairly active during the month. On the 1st, the ships arrived were 41,—market active. The prices were: Hetton Wallsend, 17*s.*; Braddyl's Wallsend, 15*s.* 3*d.*; Lambton Wallsend, 16*s.* 6*d.*; Eden Main, 14*s.* 6*d.*; Butes Tanfield Moor, 12*s.*; Tees Wallsend, 15*s.* 9*d.*; Stewart's Wallsend, 16*s.*; South Kelloe Wallsend, 14*s.* 9*d.*; Hasting's Hartley, 14*s.* 9*d.*; West Hartley, 15*s.* On the 4th, new ships 12, and more active market. On the 6th, new ships 58, market steady. On the 8th, new ships 41, reduction in prices. On the 11th, new ships 43, market dull. On the 13th, new ships 7, market firmer. On the 15th, new ships 16, market quiet. On the 18th, new ships 35, prices rose. On the 20th no market, it being the "Derby" day. On the 22nd, new ships 204, market active and prices advanced. On the 25th, new ships 94, market heavy. On the 27th, new ships 14, business dull. On the 29th, new ships 14, market heavy for house coal, but steady for Hartley's. The prices were: South Hetton Wallsend, 16*s.* 6*d.*; Stewart's Wallsend, 16*s.*; Russell's Hetton Wallsend, 14*s.* 9*d.*; Eden Main, 14*s.* 3*d.*; Hasting's Hartley, 14*s.* 9*d.*; Bute's Tanfield Moor, 13*s.* 6*d.*

LIVERPOOL.—From Messrs. J. and T. Platt's Coal Circular for May, we find that the quantity of coal, cannel, coke, and patent fuel shipped from

Liverpool to foreign and colonial ports during the month of April was 49,940 tons, against 43,623 tons during the corresponding month of last year—showing an *increase* of 6,317 tons. The total shipments from January to April were 179,243 tons, against 182,884 tons in the corresponding period last year—showing a *decrease* of 3,641 tons. The exports coastwise during April were 6,353 tons against 4,758 tons during the same month last year—showing an *increase* of 1,595 tons.

GENERAL EXPORTS.—By the Monthly Circular of Messrs. Laird, Liverpool, we learn that the quantities of coal exported during April was 729,279 tons, against 642,521 tons in the corresponding month of 1862, showing an *increase* of 86,758 tons. The particulars are—From the Northern ports, 401,629 tons; Yorkshire, 26,727 tons; Liverpool, 49,842 tons; Severn ports, 202,826 tons; and Scotch, 48,255 tons. The *increase* was —Northern ports, 44,239 tons; Yorkshire, 10,266 tons; Liverpool, 7,339 tons; Severn ports, 29,147 tons. The *decrease*—Scotch ports, 4,233 tons. —Total exports, Jan. to April, 2,264,711 tons, against 2,339,045 tons in 1862, showing a decrease of 74,334 tons.

BRISTOL.—The oversea exports of coal from Bristol during the month of April were 1,677 tons against 1,778 tons during the corresponding month last year—showing a *decrease* of 101 tons.

CONTRACTS.—The Great Eastern Railway require tenders for the supply of Locomotive Coal for twelve months. The Admiralty require the supply of 1,200 tons of South Wales Coal, delivered at Haulbowline; they also require 2,500 tons of South Wales Coal for Ascension, and 9,000 tons of South Wales Coal, for Gibraltar.

SHARE MARKETS.

LONDON, *May 29th*. The month of May has been marked by an unusual flatness in the London share market—which has been duller even than last month. Almost all mining stocks have been lower; and with one or two exceptions, the amount of speculative business has been small. To-day being the account-day there is little doing, and many of the closing prices are nominal.

The greatest amount of business continues still to be transacted in *East Caradon* shares, which have declined nearly 10*l*. per share during the month, or about 60,000*l*. on the mine. Shares opened on the 30th at 40*l*.-40½*l*., and fluctuated between 41*l*. and 39*l*. until the 8th, when they declined to 37½*l*.-38*l*. The decline continued steadily until the 13th, when they had dropped to 34¾*l*.-35½*l*. On the 15th they rallied slightly to 35¾*l*.-36¼*l*., and were quoted 36*l*.-36½*l*. on the 16th. After this date they rapidly and steadily declined until the 20th, when they touched their lowest price 30½*l*. They again rallied, however, and on the 26th were quoted 32½*l*.-33*l*.; but immediately receded to 30½*l*.-31*l*. on the 28th. They close slightly stronger at 31*l*.-31½*l*.

Marke Valley shares have been very flat, and have receded in price. They opened at 7⅞*l*.-7⅞*l*., and have uninterruptedly declined, closing at 6¼*l*.-6½*l*. *West Caradon* shares have gone on receding, and close at 4*l*. lower than our last quotations. They opened 28*l*.-29*l*., and close at 24*l*.-22*l*. *South Caradon*, 400*l*.-410*l*.

East Basset shares have fluctuated almost daily, but on the whole have advanced 16*l*. per share on our last price. They opened 87*l*.-89*l*., but on the 3rd they had advanced to 110*l*.-115*l*., and on the 7th were quoted at 115*l*.-117½*l*., the highest price they reached during the month. After the 7th they declined until the 13th, when they were as low as 87½*l*.-92½*l*. They recovered again, however, and gradually advanced to 107½*l*.-110*l*., at which they closed. *Copper Hill* shares have been quiet. They opened at

81*l.*-83*l.*, and fluctuated a little early in the month, advancing to 85*l.*-86*l.*, but they receded again to 82*l.*-84*l.* *North Basset*, 4*l.*-4½*l.* *Wheal Buller*, 59*l.*-61*l.* *Wheal Basset*, 70*l.*-75*l.*

Tincroft shares have again declined in price. They opened 21*l.*-21½*l.*, and close at 19*l.*-19½*l.* *North Roskear* shares have been completely neglected, and have declined from 30*l.*-32*l.* to 28*l.*-30*l.* *Roskearnoweth* shares have receded 3*l.* a-share, from 11*l.*-12*l.* to 8*l.*-8½*l.* *North Crofty*, 4½*l.*-5*l.* *Cook's Kitchen*, 26*l.*-27*l.* *Stray Park*, 37*l.*-38*l.* *Wheal Harriett* shares have been a little better. They opened 3¼*l.*-3½*l.*, and close 3½*l.*-4*l.* *Wheal Grenville*, 5½*l.*-5¾*l.*

Great Wheal Fortune shares have declined from 36½*l.*-37½*l.* to 34*l.*-35*l.* *Wheal Sithney Carnmeal* shares have advanced 1*l.* per share. They opened 4½*l.*-4¾*l.*, and close 5½*l.*-5¾*l.* *Wendron Consols*, 13*l.*-14*l.* *Calvadnack*, 7*l.*-8*l.* *Wheal Basset and Grylls* shares have advanced from 24*l.*-26*l.* to 26*l.*-27*l.*

West Chiverton, a lead mine in the parish of Perranzabuloe, which has hitherto been worked privately, has been purchased and brought upon the market. It is divided into 3,000 shares which are quoted at 20¼*l.*-20⅜*l.* *Chiverton*, an old mine which is being reworked, and adjoins West Chiverton, has also been included in the purchase, and similarly divided into 3,000 shares, which are quoted nominally at 7*l.* *Cargoll*, 40*l.*-41*l.* Among the eastern lead mines *Wheal Ludcott* and *Wrey* have slightly rallied from 5⅜*l.*-5½*l.* to 5½*l.*-6*l.* *Wheal Mary Ann*, 15½*l.*-16*l.* *Wheal Trelawney*, 15½*l.*-16½*l.* *Herodsfoot*, 47*l.*-48*l.*

Wheal Seton shares fluctuated considerably early in the month, but towards the close they became quiet, with little business doing. They opened 240*l.*-245*l.* On the 9th, they reached the highest price, 260*l.*-265*l.*, but quickly receded again and steadily declined to 240*l.*-242½*l.*, at which they close. *East Carn Brea* shares have declined from 8½*l.*-9*l.* to 7*l.*-7½*l.* *South Frances* have been dull. They opened 85*l.*-90*l.*, and close 75*l.*-85*l.* *Clifford Amalgamated*, 20*l.*-21*l.* *South Tolgus*, 52*l.*-52½*l.*

Providence shares have slightly declined. They opened 42*l.*-44*l.*, and close 41½*l.*-42½*l.* *Wheal Margaret* shares have continued to recede. They opened 32*l.*-33*l.*, and close 29½*l.*-30½*l.* *Wheal Kitty* (St. Agnes) shares have slightly advanced from 6*l.*-6¼*l.* to 6¾*l.*-7*l.* *Pendeen Consols*, 7*l.*-7½*l.*

In *Wheal Crebor*, a mine in the Tavistock district, there has been some amount of business doing. Shares opened at 1¾*l.*-1⅞*l.*, and have advanced to 2½*l.*-3*l.* at which they close. *Drakewalls* 2*l.*-2½*l.* *East Russell*, 4*l.*-4½*l.* *Wheal Edward* 3*l.*-3½*l.*

Transactions are also reported in the following mines:—*Gonamena*, 2*l.*-2⅝*l.* *Wheal Emma*, 1½*l.*-1¾*l.* *South Basset*, 7*l.*-8*l.* *North Dolcoath*, 2½*l.*-2¾*l.* *North Robert*, 14*s.*-16*s.* *Lady Bertha*, 17*s.* 6*d.*-20*s.* *South Herodsfoot*, 5*l.*-5½*l.* *Wheal Arthur*, 5*s.*-10*s.* *East Agar*, 11*l.*-12*l.* *Trelyon Consols*, 14*l.*-15*l.* *Wheal Grylls*, 29*l.*-30*l.* *Wheal Kitty* (Lelant), 8⅜*l.*-9*l.* *Garlidna*, 3½*l.*-4*l.* *Bottle Hill*, 12*s.*-14*s.* *East Rosewarne*, 3¼*l.*-3½*l.* *Wheal Uny*, 6¾*l.*-6⅞*l.* *Nangiles*, 10*l.*-11*l.* *Wheal Unity*, 11*s.*-13*s.*

In Welsh mines *Longrake* has been quoted at 18*l.*-20*l.* *Bryn Gwiog*, 29*l.*-30*l.*

In colonial and foreign mines business has been done at the following prices:—*Bon Accord*, ½*l.* *Cape Copper*, ½*l.*-⅝*l.* *Capula Silver*, ⅝*l.*-¾*l.* *Cobre*, 19½*l.*-20*l.* *Don Pedro North Del Rey*, 1*l.*-1⅛*l.* *Fortuna*, 4⅞*l.* *Kapunda*, 1⅛*l.*-1¼*l.* *Port Phillip*, 1⅜*l.*-1½. *Scottish Australian*, ⅝*l.* *St. John Del Rey*, 55¼*l.*-56*l.* *United Mexican*, 7⅜*l.*-7½*l.* *Yudanamutana*, 3½*l.*-3⅝*l.* *Pertusola Lead Mining and Smelting*, ⅛*l.*-¾*l.* prem. *Skara Silver*, ¼*l.*-½*l.* prem. *Terriccio Copper*, ¼*l.*-½*l.* prem.

DUBLIN.—A fair amount of business has been done in the Irish mine share market, but without any great fluctuations in price. *Wicklow Copper* opened at 28*l.* 15*s.* In the middle of the month, however, they rose to 42*l.*, but receded again, closing at 40*l.* 10*s.* *Mining Company of Ireland* shares

have been dull and have receded from 19*l.* 17*s.* 6*d.* to 19*l.* 7*s.* 6*d.* *Connorree* shares have been in request at 18*s.* 6*d.* *General Mining Company for Ireland* shares have been weak at 4*l.* 5*s.* *Carysfort* shares have been dealt in at 21*s.*

CORNWALL.—On the whole a moderate amount of business has been transacted, although it has been principally confined to a few mines. *South Crofty* shares have receded, and have been little dealt in. They opened 26*l.*-28*l.*, and close 24*l.*-26*l.* *Condurrow* shares have also receded from 120*l.* to 110*l.*, and have been flat. *New Seton*, 110*l.*-120*l.* *Rosewall Hill and Ransom United*, 3*l.* *Emily Henrietta*, 9½*l.*-10*l.* *West Tolgus*, 61*l.*-63*l.* *Wheal Rose*, 18*l.*-19*l.* *West Chiverton*, 19*l.*-20*l.*

METAL MARKETS.

LONDON, *May 29th.*—The metal market has been steadier through the month, and an almost average amount of business has been done. Prices of all kinds of metals have been fully maintained, and there has been a good advance in tin.

IRON.—The iron trade has been very dull at reduced prices.

Scotch pig-iron has been quiet at from 50*s.* 6*d.* to 51*s.*

Welsh bars have been slow of sale at declining prices, 5*l.* 5*s.* f. o. b. in Wales. Merchant bars have been in more request and have advanced in price, 5*l.* 7*s.* 6*d.* at the works, 6*l.* 2*s.* 6*d.* f. o. b. in London. Staffordshire descriptions have been in good demand at full prices. Swedish bars have been in little request; Indian specifications, ex ship, 11*l.* 5*s.* to 11*l.* 10*s.*

STEEL.—Some parcels of Swedish Keg were realised at 15*l.* in the beginning of the month, but later on some sales were effected at 15*l.* 10*s.*

COPPER.—English, both raw and manufactured, has been firm at official quotations, but there has not been a brisk demand.

Business in foreign has been very restricted but holders have been firm. Burra Burra, 94*l.* to 94*l.* 10*s.* Kapunda, 95*l.* Spanish, 87*l.* Chili, 82*l.*

YELLOW METAL.—Both sheets and sheathing have been in good steady demand. Sheets 7½*d.* to 8*d.*, sheathing 8¼*d.*

TIN.—This metal has been firm all the month, and on the 26th the smelters advanced the rates 4*l.* on refined and 3*l.* on common, at which prices a large business has been done. Straits and Banca have also advanced, and the former is in great demand at 126*l.*-127*l.* or 128*l.*-129*l.* at three months prompt. Banca, 132*l.*-133*l.* Dutch market very animated. The Dutch Trading Society have announced their annual sale of Banca tin for the 24th June next, at Amsterdam. The quantity will consist of 103,300 slabs, besides 20,000 slabs afloat, if arriving in time. Prompt as usual. No sale before June, 1864.

The sales amounted in—

1862	to	154,000	slabs, sales' price	*f.* 67.75
1861	„	149,185	„ „	69.—
1860	„	151,513	„ „	79.50
1859	„	139,128	„ „	82.50
1858	„	190,842	„ „	68.20

TIN PLATES.—This article has been dull at quoted rates.

LEAD.—The market for this metal has been very quiet, and prices have been flat at a little under our last quotations. Good soft English, 20*l.* 5*s.* to 20*l.* 10*s.*

SPELTER.—This article has been steady, but not much doing. Several transactions have been reported at 18*l.* for June shipments—parcels on the spot realised 17*l.* 15*s.* to 17*l.* 17*s.* 6*d.*, according to brands. Hull same as London. W. H., 18*l.* 10*s.*

GLASGOW, *May* 21*st*. IRON.—The pig-iron market which opened dull, improved in tone towards the end of the month. Prices opened at 50*s*. 7½*d*., and closed at 51*s*. 4½*d*. The exports during May were 55,627 tons, against 53,719 during the same month of last year—showing an *increase* of 1,910 tons.

BERLIN, *May* 17*th*. IRON.—The market for Scotch pig-iron has been dull. Iron in bars unaltered in price—3⅝–4 Thlr. Staffordshire descriptions, 5 Thlr.

TIN.—This metal has been quiet. Banca, 45 Thlr.

LEAD.—The market for this article has been firm, but without change in prices.

COPPER.—There has been little demand for this metal, and prices remain the same as our last quotations.

BRESLAU, *May* 18*th*. ZINC.—The demand for this article has been quiet at 5 Thlr. 6 Sgr. W.H., 5 Thlr. 11 Sgr.

STETTIN, *May* 16*th*. COPPER.—The market for this metal has been very dull. English, 33–34 Thlr.

TIN.—The prices for this metal are the same as those we gave last month. Banca, 44–45 Thlr.

AMSTERDAM, *May* 16*th*. TIN.—Banca has been held at 76½ fl.

SHANGHAI, *March* 25*th*. LEAD.—6-4-5 taels. Nailrod iron, 2-2 taels to 2-4 taels.

HONG KONG, *April* 1*st*. LEAD.—Quoted at 7 dollars 50 cents to 7 dollars 80 cents for common.

IRON.—Nailrod, 2 dollars 60 cents to 2 dollars 75 cents; hoop, 3 dollars 20 cents to 3 dollars 40 cents; bar, 2 dollars 60 cents to 4 dollars 10 cents. Sales of all kinds about 10,000 piculs.

Furnished by Von Dadelszen and North, 158, Leadenhall Street, London, E.C.

We have had a very quiet market in nearly every description of metal during this month, with very little business doing. Tin, however, has within the past ten days risen considerably, and a very large business has been reported in it.

IRON.—Welsh bars are quiet, without any change in price. 5*l*. 10*s*. f.o.b. Wales to 6*l*. f.o.b. here. Iron out of stock, 6*l*. 7*s*. 6*d*. per ton. Staffordshire unaltered. Scotch pig-iron closes at 50*s*. 9*d*. cash.

COPPER is slow of sale, as well for raw as manufactured, the former a trifle under official prices and the latter at fixed prices. Very little business has been done in foreign, and prices are quite nominal. Burra, 94*l*. 10*s*.; Kapunda, 95*l*.; Spanish, 87*l*.; Chili, 82*l*.

TIN.—On the 26th instant the smelters advanced the price of English 4*l*. on refined and 3*l*. on common. A very large business has been done in Straits at from 122*l*. 10*s*. for cash to 126*l*. same terms to 128*l*. three months, and it is reported that 130*l*. has been refused to-day for a parcel afloat.

Banca has risen in proportion with Straits from 128*l*., and now 132*l*. is firmly demanded.

The Dutch sale is announced for the 24th June next at Amsterdam, and will consist of 103,300 slabs, with liberty to add 20,000 if they arrive in time.

TIN PLATES are without change in price with a slack demand.

LEAD keeps steady without change in value.

SPELTER.—The market is dull and but little doing. The nominal price is 17*l*. 15*s*. here and in Hull.

PRICES CURRENT OF METALS.

From Messrs. JAMES and SHAKSPEARE'S, 10, Austin Friars, E.C. *28th May.*

							Per Ton.			
IRON	Bars	(Welch) ..	in Wales ..		——		@	£5	10	0
	„	„ ..	„ Liverpool	£6	0	0	„	6	2	6
	„	„ ..	„ London	6	7	6	„	6	10	0
	Nail Rods	„ ..	„ Wales .		——		„	6	0	0
	„	(Staffordshire)	„ Liverpool	6	12	6	„	7	0	0
	„	„	„ London	7	0	0	„	7	10	0
	Hoops	„	„ Liverpool	7	15	0	„	8	2	6
	„	„	„ London	8	5	0	„	8	10	0
	Sheets	„	„ Liverpool	8	12	6	„	9	5	0
	„	„	„ London	9	5	0	„	9	10	0
	Bars	„	„ Liverpool	6	15	0	„	7	0	0
	„	„	„ London	7	5	0	„	7	10	0
	Scotch Pig (No. 1. g.m.b.)		the Clyde		——		„	2	11	0
	Rails		in Wales		——		„	5	10	0
	Swedish—Hammered—large sizes				——		„	11	10	0
	„	„ Indian assortments		11	10	0	„	11	15	0
STEEL	Hammered—faggot			16	10	0	„	17	0	0
	„	in kegs (¼ and ⅜ in.)		15	10	0	„	16	0	0
COPPER	Burra and P.C.C.			94	0	0	„	94	10	0
Australian ..	Kapunda			95	0	0	„	97	0	0
	Wallaroo			94	0	0	„	95	0	0
American....	Baltimore				——		„	95	0	0
	Lake Superior				——		„		none	
	Spanish Cake			85	0	0	„	87	0	0
	Chili and other Slab (for 96 per cent. pure Copper)			83	0	0	„	83	10	0
English	Tough Cake and Ingot and Tile				——		„	89	0	0
	Best selected Ingot				——		„	92	0	0
	Sheets, Sheathing and Rod				——		„	96	0	0
	Flat Bottoms				——		„	101	0	0
							Per lb.			
YELLOW METAL..	Sheets						— @	8*d.*		
	Sheathing and Rod						8¼*d.* „	8½*d.*		
							Per Cwt.			
TIN	Common Blocks and Ingots				——		@	122*s.*		
English ..	„ Bars (in barrels)				——		„	123*s.*		
	Refined				——		„	128*s.*		
Foreign ..	Straits, Fine				126*s.*		„	127*s.*		
	„ (with 3 months' prompt)				128*s.*		„	129*s.*		
	Banca				132*s.*		„	133*s.*		
							Per Box.			
TIN PLATES at Liverpool 6*d.* Less	Charcoal IC, best				28*s.* 6*d.*		@	29*s.*		
	„ IX „				34*s.* 6*d.*		„	35*s.*		
	Coke IC				22*s.* 6*d.*		„	25*s.*		
	„ IX				28*s.* 6*d.*		„	31*s.*		
							Per Ton.			
LEAD	Sheet				——		@	£21	0	0
English ..	Pig—W.B.				——		„	23	0	0
	„ Other good brands			20	10	0	„	20	15	0
	„ German and Spanish, soft			20	0	0	„	20	5	0
English ..	Red				——		„	21	15	0
	Shot				——		„	23	10	0
	Dry White				——		„	26	0	0
SPELTER	(Silesian) in Cakes			17	17	6	„	18	0	0
ZINC	(Sheet) No. 9 and upwards				——		„	23	5	0
							Per Bottle.			
QUICKSILVER	(in bottles containing 75lbs. each)				——		@	7	0	0
							Per Ton.			
REGULUS OF ANTIMONY, French Star					——		@	40	0	0

Tabular Abstract of Mining Accounts for the Month.

Date of Account.	Name of Mine, and Number of Shares.	Balances. Debit.	Balances. Credit.	Calls. Per Share.	Calls. Total.	Dividends. Per Share.	Dividends. Total.
	CORNISH AND DEVON MINES.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
April 20	Wheal Trannack (512)	—	—	0 4 0	102 8 0	—	—
„ 21	New Trevenen (960)	512 0 0	—	0 7 0	336 0 0	—	—
„ 22	New Hendra (400)	11 19 0	—	0 5 0	100 0 0	—	—
„ 22	Clifford Amalgamated (2,900)	362 13 6	—	—	—	—	—
„ 22	North Basset (6,000)	481 7 8	—	0 4 0	1,200 0 0	—	—
„ 22	West Caradon (1,024)	627 12 0	—	—	—	—	—
„ 23	North Jane (2,000)	—	—	0 10 0	1,000 0 0	—	—
„ 23	Great South Tolgus (6,000)	—	134 0 0	—	—	—	—
„ 23	Hingston Down (6,000)	—	427 17 4	—	—	—	—
„ 23	Lady Bertha (6,000)	816 0 0	—	0 3 0	900 0 0	—	—
„ 23	St. Ives Wheal Allen (1,024)	314 17 11	—	0 6 1	307 19 4	—	—
„ 24	North Downs (6,000)	273 0 0	—	0 2 6	750 0 0	—	—
„ 24	North Great Work (6,000)	164 11 5	—	0 2 0	600 0 0	—	—
„ 27	East Pool (128)	—	821 8 2	—	—	5 0 0	640 0 0
„ 28	Peendeen Consols (5,000)	—	75 7 11	—	—	—	—
„ 28	Penhalls (5,000)	681 0 0	—	—	—	—	—
„ 29	New Crow Hill (6,400)	389 16 7	—	—	—	—	—
„ 30	Great Wheal Busy (6,000)	4,325 0 0	—	0 14 6	4,350 0 0	—	—
„ 30	Tincroft (6,000)	—	2,291 0 0	0 5 0	1,500 0 0	—	—
„ 30	Illogan Mining Co. (6,000)	—	3 19 11	0 2 6	750 0 0	—	—
„ 30	East Jane (6,145)	—	99 9 2	0 3 6	1,070 7 6	—	—
„ 30	Wendron United (960)	—	—	0 4 9	228 0 0	—	—
May 1	Great North Downs (5,000)	—	—	0 10 0	2,500 0 0	—	—
„ 1	Great Briggan (5,000)	3,681 0 0	—	0 14 6	3,625 0 0	—	—
„ 1	Charlotte United (6,000)	1,756 4 2	—	0 6 0	1,800 0 0	—	—
„ 4	South Frances (496)	—	1,450 10 4	—	—	1 0 0	496 0 0
„ 5	Grambler and St. Aubyn (486)	179 17 3	—	1 0 0	486 0 0	—	—
„ 5	S. Caradon Wh. Hooper (4,096)	243 8 11	—	0 2 0	409 12 0	—	—
„ 6	East Grenville (6,000)	588 5 1	—	0 2 0	600 0 0	—	—
„ 6	Wheal Crebor (6,000)	—	31 9 9	0 1 6	450 0 0	—	—
„ 6	Great Wheal Fortune (1,798)	—	2,644 8 3	—	—	0 15 0	1,348 10 0
„ 6	East Wheal Martha (6,000)	—	—	0 5 0	1,500 0 0	—	—
„ 7	Calvadnack (915)	270 6 0	—	—	—	—	—
„ 7	West Frances (512)	929 4 7	—	2 0 0	1,024 0 0	—	—
„ 8	West Maria and Fortescue (12,000)	470 12 10	—	0 1 0	600 0 0	—	—
„ 11	Great Wheal Baddern (3,730)	1,442 13 3	—	0 10 0	1,865 0 0	—	—
„ 12	North Roskear (700)	130 14 4	—	—	—	—	—
„ 12	Roskearnoweth (700)	113 14 1	—	1 0 0	700 0 0	—	—
„ 12	West Grylls (6,000)	78 5 7	—	—	—	—	—
„ 12	Frank Mills (5,000)	517 8 5	—	—	—	—	—
„ 13	Bampfylde (10,000)	—	580 5 10	—	—	—	—
„ 13	South Condurrow (6,138)	613 5 10	—	0 2 0	613 16 0	—	—
„ 13	Holmbush (10,000)	1,077 7 9	—	0 5 0	2,500 0 0	—	—
„ 14	Cargoll (916)	—	2,147 0 0	—	—	1 5 0	1,145 0 0
„ 14	Wh. Sithney Carnmeal (2,048)	1,090 19 1	—	0 10 0	1,024 0 0	—	—
„ 15	Wheal Owles (80)	—	2,083 12 8	—	—	5 0 0	400 0 0
„ 18	Wheal Emily Henrietta (1,024)	134 3 3	—	0 15 0	768 0 0	—	—
„ 18	West Damsel (256)	—	579 0 0	—	—	—	—
„ 18	New Rosewarne (1,024)	521 13 5	—	1 0 0	1,024 0 0	—	—
„ 19	Wheal Buller (256)	—	304 0 8	—	—	—	—
„ 19	St. Ives Consols (940)	—	—	—	—	0 10 0	470 0 0
„ 19	Wheal Unity Consols (6,000)	1,329 15 2	—	0 4 0	1,200 0 0	—	—
„ 20	Gurlyn (4,910)	1,688 7 2	—	0 6 10½	1,728 14 7	—	—
„ 20	Wheal Grenville (6,000)	119 12 11	—	—	—	—	—
„ 22	Devon Great Consols (1,024)	—	31,862 3 3	—	—	9 0 0	9,216 0 0
„ 23	Wheal Trerew (2,048)	—	67 18 10	—	—	—	—
	WELSH & IRISH MINES.						
April 27	Bronfloyd (5,000)	—	1,214 6 2	—	—	0 2 0	500 0 0
„ 27	Clara United (4,000)	204 8 2	—	0 2 6	500 0 0	—	—
„ 29	Rhafna (5,000)	—	556 15 8	—	—	—	—
„ 30	Bryntail (1,861)	66 12 10	—	0 4 0	372 4 0	—	—
May 1	Minera (1,800)	—	—	—	—	7 0 0	12,600 0 0
„ 12	Bryn Gwiog (500)	—	337 0 2	—	—	—	—
„ 12	Long Rake (500)	573 18 10	—	1 10 0	750 0 0	—	—
„ 15	Nanty-y-Iago (2,400)	415 11 3	—	0 5 0	600 0 0	—	—
„ 19	Wicklow Copper (5,000)	—	—	—	—	1 0 0	5,000 0 0
	FOREIGN MINES.						
May 6	United Mexican (43,174)	—	—	—	—	0 7 6	16,190 5 0
„ 7	Lusitanian (10,000)	—	1,752 0 0	—	—	—	—
„ 22	Bon Accord (75,000)	—	48,580 11 7	—	—	—	—

Copper Ores.

Sampled April 15, and sold at the Tabb's Hotel, Redruth, April 30.

Mines.	Tons.	Purchasers.	Price.
South Caradon	101	11	£5 6 9
	92	5	4 11 0
	91	1, 6	8 12 6
	64	2	5 16 6
	58	5	13 15 0
	55	1, 3, 5	16 5 6
	34	1	5 8 6
Great Wheal Busy ...	72	10	1 12 6
	69	9	2 9 0
	68	6	2 10 6
	63	7	3 10 0
	55	6	2 13 3
	46	1	1 10 6
	39	6, 9	4 0 6
	10	7	3 14 0
	2	1	40 0 0
Fowey Consols	79	1, 5	6 8 0
	78	1	5 5 6
	77	7	4 17 0
	75	1	5 6 6
	70	7	3 3 0
	36	5	5 1 0
West Damsel.....	87	9	2 13 0
	70	3	3 9 0
	69	3, 6	3 16 6
	68	6, 9	2 19 6
	60	3	3 11 6
	39	6	3 17 6
Clifford Amalgamated	81	5	3 15 0
	60	10	1 0 6
	51	7	3 3 0

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	30	14	£3 9 6
	29	6	3 7 0
	26	3	6 6 0
	19	5	0 19 0
	17	5	0 9 0
Tywarnhaile	64	12	2 9 6
	57	3	4 4 6
	39	10	1 3 0
	38	3	10 9 6
	37	3	2 16 0
Craddock Moor.....	84	6, 13	7 0 6
	64	9	5 4 6
	24	9	4 14 0
	20	5	2 18 0
	14	2	3 8 0
Great Brigan.....	75	6, 13	3 16 0
	32	13	5 13 6
New Treleigh	41	10	3 4 0
	29	10	1 19 6
Bampfylde	57	1, 5	13 1 0
Molland	50	14	5 0 6
Great North Downs...	42	2, 13	5 3 6
Falmouth & Sperries	21	1, 5	4 0 0
	19	1, 5	3 0 6
North Grambler	38	6	5 1 6
Pedn-an-drea	29	14	3 16 6
Grambler & St. Aubyn	12	5	5 9 6
Wheal Jane	9	1, 5	3 5 6
Furze Park	5	2	10 17 0
Wheal Prosper	4	12	3 5 6

TOTAL PRODUCE AND VALUE.

	Tons	Amount.
South Caradon	495	£3,988 13 0
Great Wheal Busy.....	430	1,190 6 6
Fowey Consols	415	2,092 3 6
West Damsel	393	1,303 18 0
Clifford Amalgamated ...	313	916 16 0
Tywarnhaile	235	944 15 6
Craddock Moor	206	1,142 18 0
Great Brigan	107	466 12 0
New Treleigh	70	188 9 6
Bampfylde	57	743 17 0

	Tons.	Amount.
Molland	50	£251 5 0
Great North Downs.....	42	217 7 0
Falmouth and Sperries ...	40	141 9 6
North Grambler	38	192 17 0
Pedn-an-drea	29	110 18 6
Grambler & St. Aubyn ...	12	65 14 0
Wheal Jane	9	29 9 6
Furze Park	5	54 5 0
Wheal Prosper...	4	13 2 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	391¼	£2,546 8 9
2 Freeman and Co.	104	583 6 6
3 Grenfell and Sons	340 5-6	1,791 13 3
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co ...	474 5-6	2,956 15 6
6 Williams, Foster & Co.	413	1,803 0 3
7 Mason and Elkington...	277	1,034 6 0
8 Bankart and Sons	—	—

	Tons.	Amount.
9 Copper Miners' Co.....	297½	£1,026 8 9
10 Charles Lambert	241	411 16 6
11 Newton, Keates & Co...	101	535 6 0
12 Sweetland, Tuttle & Co.	68	171 10 0
13 Neath Copper Co.	132½	727 16 6
14 Penclawdd Copper Co.	109	466 8 6
Total	2950	£14,054 16 6

Average Produce, 6¼.
Quantity of Fine Copper, 196 tons 0 cwts.

Average Standard £113 2 0
Average Price per ton 4 15 0

Blende Sale.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
May 1.	Minera	25 ...	2 15 0 ...	Vivian & Sons	254 10 0
	,, ...	45 ...	3 7 0 ...	ditto	
	,, ...	20 ...	1 15 0 ...	ditto	

Copper Ores.

Sampled April 22, and sold at Tyack's Hotel, Camborne, May 7.

Mines.	Tons.	Purchasers.	Price.		
Clifford Amalgamated	105	1, 6	£6	17	0
	100	6	6	8	0
	99	1	6	5	6
	90	6	6	9	0
	85	8	3	2	0
	82	5, 10	3	0	0
	72	2, 13	3	17	6
	70	9	3	17	6
	60	1	6	8	6
	55	2	6	10	0
	31	8	4	15	0
	25	10	2	2	0
West Seton	86	9, 12	6	7	6
	76	10	2	3	6
	69	9	5	0	6
	62	10	3	14	6
	60	7	6	16	0
	56	5, 12	6	11	6
	54	8	2	13	6
	51	14	2	12	6
	46	7	7	18	0
Wheal Seton	29	3	5	6	6
(Pendarves)	98	9	4	2	0
	81	3	5	11	6
	51	3	5	2	6
	16	7	1	8	0
	13	1	13	5	6
	6	5	2	7	0
South Tolgus	61	5	5	8	0
	60	6	7	5	6
	52	3	5	7	6
	42	10, 13	3	2	6
	36	5	6	5	0
East Pool	103	10	4	16	6
	83	8, 14	4	0	0
	60	8	4	5	0

Mines.	Tons.	Purchasers.	Price.		
Wheal Grenville	41	10	£2	9	6
	40	1, 5	7	8	6
	39	5	6	9	0
	38	1, 5	8	17	0
	32	12	3	18	6
	24	1	8	13	6
North Roskear (Enys)	55	16	8	6	6
	47	3	6	19	0
	41	10	2	5	6
(Pendarves)	42	2	4	14	0
(Basset)	26	13	3	13	0
South Frances	82	1, 13	5	1	6
	46	7	7	8	0
	40	1, 9, 13	5	16	6
	30	3	6	5	6
Tolcarne	55	9	5	2	0
	49	10	3	6	6
	36	10	3	12	0
	35	7	1	9	6
Wheal Basset	66	1, 13	5	6	6
	55	1, 6	6	7	6
	51	1, 2, 3	6	9	6
East Basset	43	1	7	1	6
	42	1, 13	5	2	6
	25	1	12	1	6
	24	12, 14	4	7	6
West Stray Park	46	6	4	9	6
	39	9	8	3	6
Wheal Harriett	45	2, 10, 12	2	0	6
	33	9	5	3	0
West Tolgus	50	9	4	0	6
East Grenville	24	10	3	10	0
	18	5	1	17	0
North Crofty	40	2, 13, 14	5	7	6
South Basset	21	12	2	11	6
Wheal Moyle	7	12	1	19	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Clifford Amalgamated	874	£4,563	9	6
West Seton	560	2,707	16	0
Wheal Seton	294	1,478	5	0
South Tolgus	251	1,401	13	0
East Pool	246	1,083	19	6
Wheal Grenville	214	1,320	2	6
North Roskear	211	1,170	2	0
South Frances	198	1,177	16	0
Tolcarne	175	624	13	0

	Tons.	Amount.		
Wheal Basset	172	£1,032	6	0
East Basset	134	926	7	0
West Stray Park	86	524	13	6
Wheal Harriett	78	261	1	6
West Tolgus	50	201	5	0
East Grenville	42	117	6	0
North Crofty	40	215	0	0
South Basset	21	54	1	6
Wheal Moyle	7	13	16	6

EACH COMPANY'S PURCHASE.

		Tons.	Amount.		
1	Vivian and Sons	535 5-6	£3,753	5	10
2	Freeman and Co.	178½	906	10	4
3	Grenfell and Sons	307	1,771	17	0
4	Crown Copper Co.	—	—		
5	Sims, Willyams & Co.	268	1,477	2	0
6	Williams, Foster & Co.	403½	2,626	14	6
7	Mason and Elkington	203	1,185	16	6
8	Bankart and Sons	271½	974	17	0

		Tons.	Amount.		
9	Copper Miners' Co.	407½	£2,342	1	10
10	Charles Lambert	534	1,736	0	0
11	Newton, Keates & Co.	—	—		
12	Sweetland, Tuttle & Co.	158	734	12	0
13	Neath Copper Co.	204½	940	15	8
14	Penclawdd Co.	117 5-6	424	0	10
	Total	3652	£18,873	13	6

Average Produce, 7½.
Quantity of Fine Copper, 261 tons 5 cwts.

Average Standard £110 14 0
Average Price per ton 5 3 6

Copper Ores.

Sampled April 29, and sold at Tabb's Hotel, Redruth, May 14.

Mines.	Tons.	Purchasers.	Price.
West Basset	104	9	£4 1 6
	101	10	3 17 6
	72	3	7 6 0
	68	7	7 14 0
	51	1, 5	10 13 6
	45	9	5 13 0
	42	7	3 19 0
	41	7	3 2 6
Levant	8[illegible]	1	6 12 6
	81	1	1 1 6
	80	8	5 18 6
	60	6	5 6 6
	42	1	6 16 6
	2	1	12 0 0
East Carn Brea	60	3	4 13 0
	51	3	4 19 6
	49	3, 9	3 16 0
	43	3	4 10 6
	42	6, 13	5 14 6
	19	9	2 19 6
	17	10	2 17 0
Alfred Consols	69	6, 10, 13	3 5 6
	68	6, 13	4 7 6
	53	6, 7, 10	1 8 6
	30	6	4 11 6
Prosper United	110	5	3 11 0
	77	5	2 15 0
Par Consols	58	9	4 15 0
	54	1, 6	9 2 6
	47	2	5 9 6
Wheal Margery	54	10	2 3 0
	46	5	7 3 6
	45	10	2 9 0
	5	5	7 14 0
Botallack	91	1, 5	8 0 6

Mines.	Tons.	Purchasers.	Price.
Botallack	40	6, 13	£3 16 6
	15	6	8 11 6
Wheal Anna	105	2, 6	5 14 6
	15	5	2 17 0
Tolvadden	48	7	3 8 6
	33	10, 12	2 4 6
	31	6	5 15 6
	7	1	9 9 0
Copper Hill	47	1	6 3 0
	38	10	2 3 6
	32	10	1 8 6
East Rosewarne	50	1, 3, 5, 9	7 8 0
	32	3, 9	11 9 6
	31	3	6 3 6
Gurlyn	50	10	5 2 6
	38	5	5 7 0
West Alfred Consols	50	1	0 17 0
	14	13	0 12 0
	12	8	3 18 6
Wheal Buller	56	10	3 3 0
	10	1	11 12 0
North Basset	26	10	3 15 6
	24	1, 10	2 12 6
	14	10	1 9 6
South Crenver	43	9	2 1 6
	15	5, 9	6 8 0
East Alfred Consols	36	1, 5	3 18 6
South Carn Brea	25	5	2 17 6
Wheal Agar	20	2	5 5 0
North Frances	17	2	5 11 0
West Whl. Trevelyan	17	5	3 12 0
Wheal Florence	14	1	8 12 0
St. Aubyn and Grylls	4	1	4 1 6
Wheal Trenwith	2	5	11 12 6
Castle & Boswidden	1	5	41 7 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
West Basset	524	£2,958 15 6
Levant	347	1,734 9 6
East Carn Brea	281	1,258 18 6
Alfred Consols	220	736 5 0
Prosper United	187	602 5 0
Par Consols	159	1,025 11 6
Wheal Margery	150	594 18 0
Botallack	146	1,011 18 0
Wheal Anna	120	643 17 6
Tolvadden	119	483 0 0
Copper Hill	117	417 6 0
East Rosewarne	113	927 16 6
Gurlyn	88	459 11 0

	Tons.	Amount.
West Alfred Consols	76	£98 0 0
Wheal Buller	66	292 8 0
North Basset	64	181 16 0
South Crenver	58	185 4 6
East Alfred Consols	36	141 6 0
South Carn Brea	25	71 17 6
Wheal Agar	20	105 0 0
North Frances	17	94 7 0
West Wheal Trevelyan	17	61 4 0
Wheal Florence	14	120 15 0
St. Aubyn and Grylls	4	16 6 0
Wheal Trenwith	2	23 5 0
Castle and Boswidden	1	41 7 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	479½	£2,670 2 0
2 Freeman and Co.	136⅛	757 4 9
3 Grenfell and Sons	310	1,813 2 6
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	445	2,263 1 0
6 Williams, Foster & Co.	331 1-6	1,757 6 3
7 Mason and Elkington	216⅛	1,008 18 0
8 Bankart and Sons	92	521 2 0

	Tons.	Amount.
9 Copper Miners' Co.	329½	1,516 2 0
10 Charles Lambert	502 1-6	1,514 11 9
11 Newton, Keates & Co.	—	—
12 Sweetland, Tuttle & Co.	16⅛	36 14 3
13 Neath Copper Co.	112	429 4 0
14 Penclawdd Co.	—	—
Total	2971	£14,287 8 6

Average Produce, 6¾.
Quantity of Fine Copper, 202 tons 5 cwts.

Average Standard £111 1 0
Average Price per ton 4 16 0

Copper Ores.

Sampled May 6, and sold at the Royal Hotel, Truro, May 21.

Mines.	Tons.	Purchasers.	Price.
Devon Great Consols	127	6, 13	£5 5 6
	123	10	4 11 0
	122	1	4 18 6
	120	6, 13	4 19 6
	118	2, 6	4 17 6
	115	1, 2	5 5 6
	112	11	4 5 6
	110	12	5 4 0
	107	1, 6	3 15 0
	105	1	5 7 6
	104	9	5 4 6
	102	3, 6, 13	4 16 6
	100	6, 11	5 0 6
	88	3, 6	4 16 6
	87	5	5 1 0
	86	3, 5	9 17 0
	78	14	2 8 6
	74	6	5 1 6
	62	9, 10	4 13 6
	61	1	9 7 6
	55	1, 10	3 17 6
	47	10	1 18 0
	23	1	2 10 0
	22	1	6 6 6
	18	7	3 3 6
Phœnix Mines	91	10	2 19 6
	87	10	2 3 0
	85	3	4 7 6
	81	3	7 10 6
	79	7, 10	1 14 6
	60	3, 7	4 6 6
East Caradon	90	6	3 14 6
	87	1	3 10 6
	78	1, 10	3 2 6
	70	1, 5	3 6 6
	54	5	6 16 0
	52	6	5 13 6
	49	5	6 13 0
New Wheal Martha	93	1, 5	2 10 6
	84	1, 5	2 6 0
	80	1, 5	2 15 6
	60	1, 5	2 17 0
	54	1, 5	2 15 6
	35	1, 5	1 16 6
	20	1, 5	8 15 6

Mines.	Tons.	Purchasers.	Price.
Hingston Down	79	9	£2 15 6
	78	8	2 16 6
	66	8	4 18 6
	64	9	2 13 6
	63	3	3 2 6
	55	9	3 13 0
Marke Valley	84	12	2 18 6
	83	5	2 13 0
	80	9	2 13 6
	64	3	4 16 6
	53	1, 3, 10	1 8 6
	36	5	1 7 6
Wheal Edward	61	10	4 9 0
	48	10	3 11 0
	47	2	3 4 0
	43	10	1 8 0
	23	2	4 2 0
Bedford United	107	6	4 14 6
	99	11	4 6 6
Kelly Bray	109	3, 7, 9	5 16 6
	61	2	1 17 6
	36	2	5 4 0
Holmbush	53	1, 5	9 3 0
	52	6	9 0 6
	51	1, 5	2 19 6
	34	1, 5	2 19 6
Wheal Friendship	75	10	2 15 0
	55	1	2 8 6
	52	13	9 6 6
Wheal Yarner	175	1, 5	2 10 6
East Russell	54	6	4 17 0
	50	13	3 9 6
	48	7	3 12 6
Wheal Emma	56	12	3 9 6
	48	1	1 7 6
	28	9	5 15 0
Brookwood	60	1	3 7 6
	30	6	5 16 6
	10	1	8 12 6
Lady Bertha	45	7, 9	2 7 0
	41	12	1 5 6
Wheal Crebor	82	9	3 6 6
Collacombe	27	7	3 1 6
Fursdon	25	5	2 17 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2,166	£10,857 9 6
Phœnix Mines	484	1,837 2 0
East Caradon	480	2,106 11 6
New Wheal Martha	426	1,210 5 0
Hingston Down	405	1,333 9 0
Marke Valley	400	1,193 9 6
Wheal Edward	222	746 15 0
Bedford United	206	933 15 0
Kelly Bray	206	936 10 0
Holmbush	190	1,207 2 6
Wheal Friendship	182	£824 10 6
Wheal Yarner	175	441 17 6
East Wheal Russell	152	609 13 0
Wheal Emma	132	421 12 0
Brookwood	100	463 10 0
Lady Bertha	86	158 0 6
Wheal Crebor	82	272 13 0
Collacombe	27	83 0 6
Fursdon	25	71 17 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Vivian and Sons	1,192¾	£4,796 19 0
2 Freeman and Co.	282¼	1,137 4 3
3 Grenfell and Sons	498	2,653 10 10
4 Crown Copper Co.	—	—
5 Sims, Willyams & Co.	781½	3,208 2 6
6 Williams, Foster & Co.	823	4,167 14 3
7 Mason and Elkington	191½	646 16 7
8 Bankart and Sons	174	675 3 0
9 Copper Miners' Co.	581 5-6	£2,271 13 4
10 Charles Lambert	730¾	2,283 17 0
11 Newton, Keats & Co.	261	1,151 4 6
12 Sweetland, Tuttle & Co.	291	1,064 11 6
13 Neath Copper Co.	259½	1,456 3 9
14 Penclawdd Copper Co.	78	189 3 0
Total	6,146	£25,709 3 6

Average Produce, 5¼.
Quantity of Fine Copper, 363 tons 14 cwts.

Average Standard £117 3 0
Average price per ton 4 3 6

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
April 23.	Maesyssfn	50	12 6 6	Walker, Parker & Co	616 5 0
	Hendre Ucha	13	11 18 0	Adam Eyton	149 14 0
	Bryngwyn	9	12 12 0	Walker, Parker & Co.	211 15 0
	"	7	14 1 0	Adam Eyton	
	Pant-y-Mwyn	13	11 6 0	Walker, Parker & Co.	264 13 0
	"	5	11 15 6	ditto	
	"	5	11 15 6	Newton, Keates & Co.	
	Pant-y-Buarth	10	12 0 6	ditto	120 5 0
	Dyliffe	70	12 7 6	Adam Eyton	866 5 0
	Roman Gravels	30	12 13 0	Walker, Parker & Co.	379 10 0
	Llanerchyraur	10	13 2 6	Newton, Keates & Co.	262 10 0
	"	10	13 2 6	Adam Eyton	
	Severn	1½	12 5 0	Walker, Parker & Co.	18 7 0
	North Laxey	10	13 0 0	Stock & Co.	260 0 6
	"	10	13 0 0	Panther Co.	
" 24.	Cwmbrane	11	12 13 0	Sims, Willyams & Co.	139 3 0
" 29.	Isle of Man Mining Co.	100	22 1 6	Treffry's Trustees	3275 5 0
	"	75	14 5 0	ditto	
	Trelawny	63	27 13 6	—	1743 10 6
May 1.	Minera	105	13 10 0	Panther Co.	6935 8 0
	"	104	13 7 6	ditto	
	"	100	13 6 0	Sims, Willyams & Co.	
	"	106	13 12 6	Panther Co.	
	"	100	13 11 6	ditto	
	South Exmouth	65	11 11 0	ditto	750 15 0
	Wheal Frank Mills	40	16 5 0	Stock & Co.	1374 12 6
	"	55	13 3 6	ditto	
" 4.	Penrallt	20	10 15 0	Adam Eyton	430 0 0
	"	20	10 15 0	Walker, Parker & Co.	
	East Logylas	25	12 10 0	Panther Co.	625 0 0
	"	25	12 10 0	Sims, Willyams & Co.	
	Glogfach	60	15 10 0	ditto	930 0 0
	Cwmystwith	100	12 16 0	ditto	1280 0 0
" 6.	North Minera	13½	12 1 6	Walker, Parker & Co.	163 0 3
" 8.	Dyfngwm	27	12 4 0	ditto	329 8 0
	Aberdovey	8	11 11 6	Adam Eyton	92 12 0
	Cargoll	85	16 10 0	—	1402 10 0
" 9.	Wheal Mary Ann	16	25 0 0	Pontifex & Wood	1925 15 0
	"	16	25 0 0	Stock & Co.	
	"	15	25 0 0	J. and J. Williams	
	"	26	13 5 0	ditto	
" 14.	Talargoch (Maesyrerwddu)	60	13 15 6	Adam Eyton	2229 0 0
	" (Coetia Llys)	100	14 0 6	Walker, Parker & Co.	
	Deep Level	8	12 12 0	Adam Eyton	100 16 0
	Rhosesmor	10	12 7 6	ditto	123 15 0
	Parry's	31	12 16 6	Walker, Parker & Co.	397 11 6
	Bryn Gwiog	45	12 17 6	ditto	579 7 6
	Long Rake	15	12 15 6	Adam Eyton	191 12 6
	Holywell Level	7	14 8 6	ditto	100 19 6
	North Henblas	10	12 1 6	Walker, Parker & Co.	130 15 0
	Minera Union	15	12 3 6	Newton, Keates and Co.	182 12 6
	Dyliffe	38	12 9 0	Adam Eyton	969 2 0
	"	40	12 8 0	ditto	
	Llangynog United	37	12 4 6	Newton, Keates & Co.	440 2 0
	Park	12½	12 4 6	ditto	305 12 6
	"	12½	12 4 6	Walker, Parker & Co.	
	Nant-y-Iago	20	11 17 6	Newton, Keates & Co.	237 10 0
	Bryntail	2½	11 2 6	Walker, Parker & Co.	27 16 3
	Orsedd	5	12 7 0	Adam Eyton	61 15 0
	Llanerchyraur	25	12 17 0	Newton, Keates & Co.	321 5 0
" 18.	Frongoch	85	12 10 0	Panther Co.	2135 12 6
	"	85	12 12 6	ditto	
	East Darren	80	15 2 6	ditto	1210 0 0
	Cefn Brwyno	42	12 10 6	ditto	526 1 0
	Cwm Erfin	25	15 12 6	ditto	955 0 0
	"	35	16 2 6	J. & J. Williams	
	Bronfloyd	50	13 7 6	Panther Co.	668 15 0
	Newtownards	50	12 11 0	Walker, Parker & Co.	627 10 0